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Aviation Electronics

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Build an Electronic Motor Speed Control

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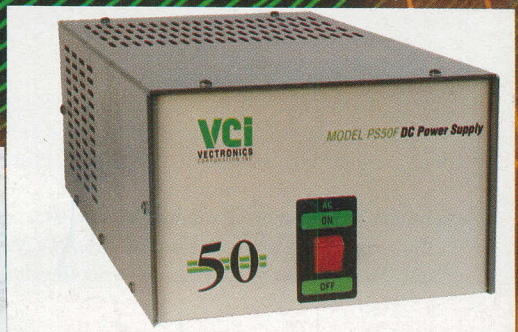

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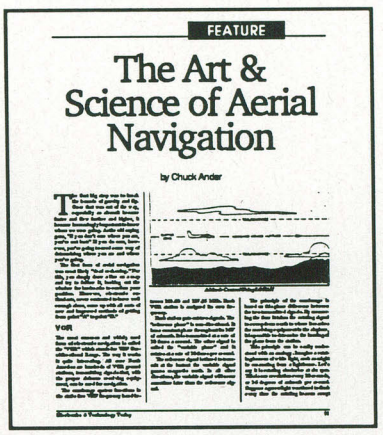

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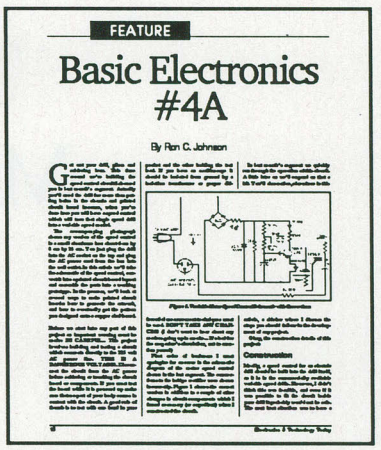

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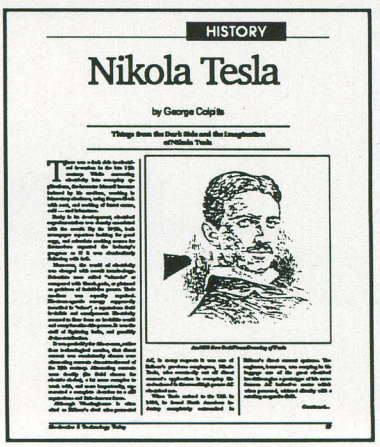

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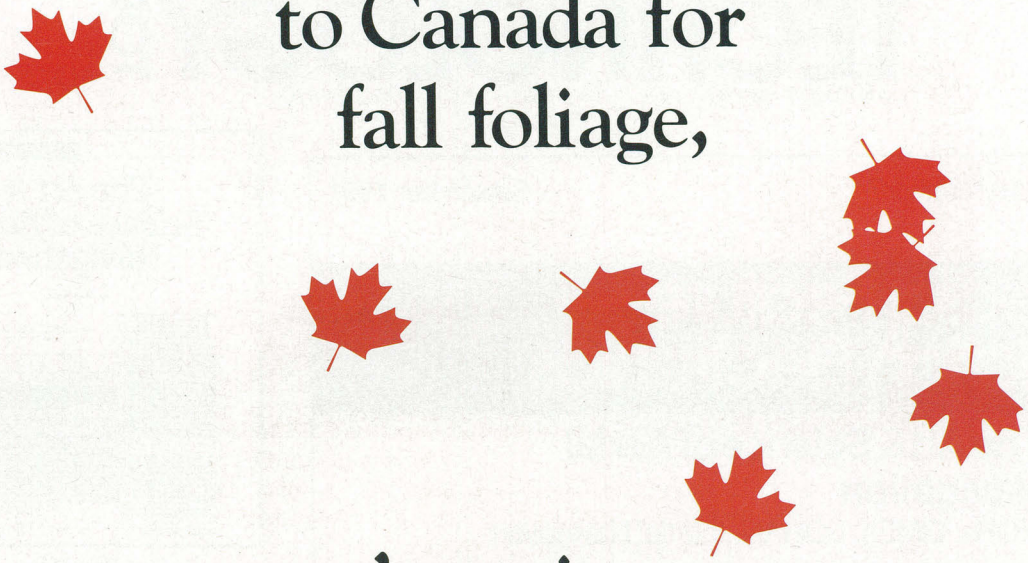
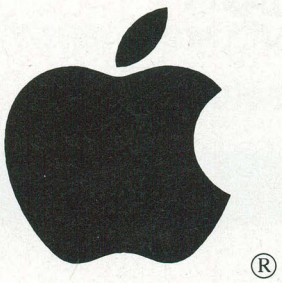
Some people travel to Canada for fall foliage,



we're going to Toronto for the Macintosh harvest . . .



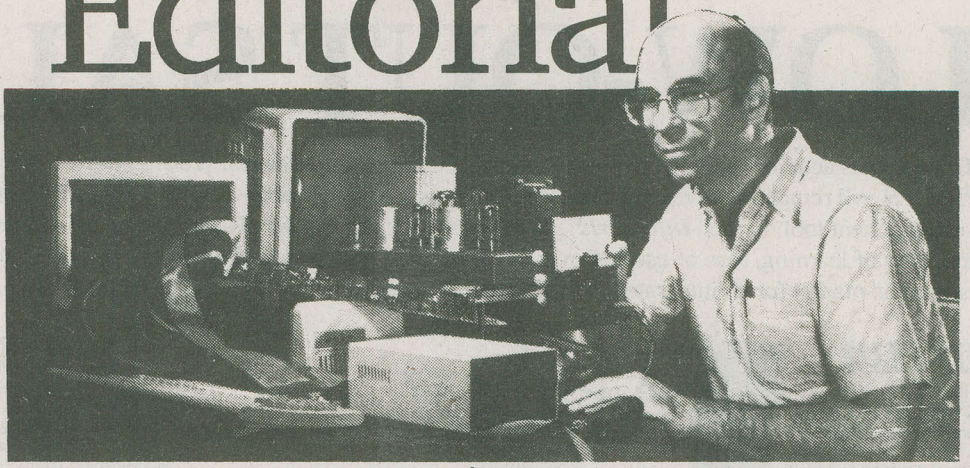
Mark your calendars early!

It will be a bumper crop at Macworld Expo/Canada, from October 8 – 10, at the Better Living Centre in Toronto. You can see the latest in Macintosh technology, and get great deals on hardware and software for the coming year. Whether or not you use the Mac, it's the one event you can't afford to miss! For information about exhibiting at or attending Macworld Expo/Canada, call (416) 581-8797 or the Macworld Expo/Canada hotline, (416) 591-2447.

MACWORLD EXPOSITION

Canada, October 8–10, 1991

Editorial



I can hardly believe the summer is almost over. It was a good one, wasn't it? As we head into the fall, I have to think about planning the 1992 editorial calendar, or in other words, what to write about. This is where you come in. I've tried to feature many different subjects related to electronics in the different issues. I hope I've provided a good assortment of topics.

What would you like to read about? Please send me some suggestions and I'll try to include them in next year's topics.

So have a great autumn and I'm looking forward to hearing from you.

Chuck Ander
Editor

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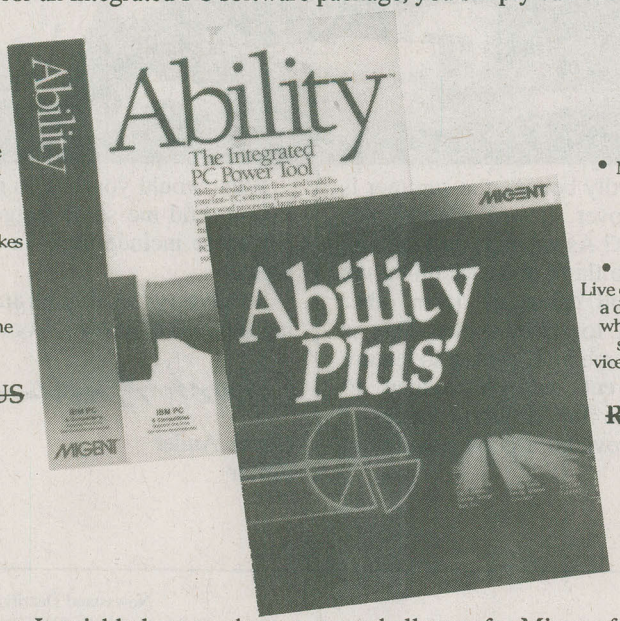

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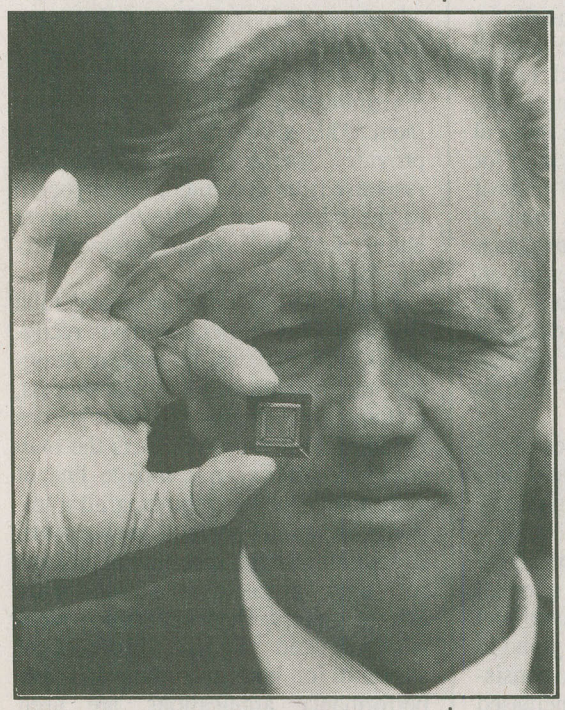
New Products

Camera On A Silicon Chip

This miniature video camera — about the size of a postage stamp — can be produced for about £25 using world-leading technology developed by research scientists at Edinburgh University, Scotland. They have discovered a way to integrate an image sensor with the other camera electronics on a single silicon chip, to which a tiny lens can be attached. As well as being ten to a hundred times less costly to produce than existing charge coupled device (CCD) cameras, it is small and inexpensive enough to open up the prospect of many new uses for a camera of this type, including video "toys." Its power consumption is much lower than that of existing cameras, making it particularly suitable for space and portable battery-powered uses. The prototype unit takes only one-tenth of a watt to capture, process and output a standard video signal



The Edinburgh researchers have developed a way of using the same commonly available and inexpensive complementary metal oxide semiconductor (CMOS) technology (normally used for camera electronics) to produce images with a quality indistinguishable from CCD images. This enables a high-resolution detector comprising an array of CMOS photodiodes to be fully integrated with the other circuitry on a very large-scale integrated (VLSI) chip about 8mm square, containing almost 100,000 transistors. These include transistors providing digital logic for automatic camera exposure control and formatting the video output signal.

While the first of the new integrated cameras produces only monochrome pictures, the scientists are now working on a colour model.

Potential applications for the new micro-camera technology include security, machine vision, medical imaging, robotics and consumer products — including the possibility of a cheap video telephone.

The new technology is the subject of a number of patents and a company known as VLSI Vision Ltd. has been formed to work with industrial partners and provide manufacturing licences. For more information contact: VLSI Vision Ltd, Technology Transfer Centre, University of Edinburgh, King's Buildings, Mayfield Road, Edinburgh, Scotland EH9 3JL. Tel: +44 31 668 1550. Fax: +44 31 662 4678.

Circle No. 18 on Reader Service Card

PROTEL Software: Even Greater Flexibility!

Innovative Devices, Inc. (IDI), Canadian Distributor for PROTEL Professional Quality CAD Software announces two additions to their product line.

Massteck has added PROTEL's Autotrax to their list of compatible software. MaxRoute's shove technology avoids the kind of quality and productivity problems associated with typical rip-up and retry routing.

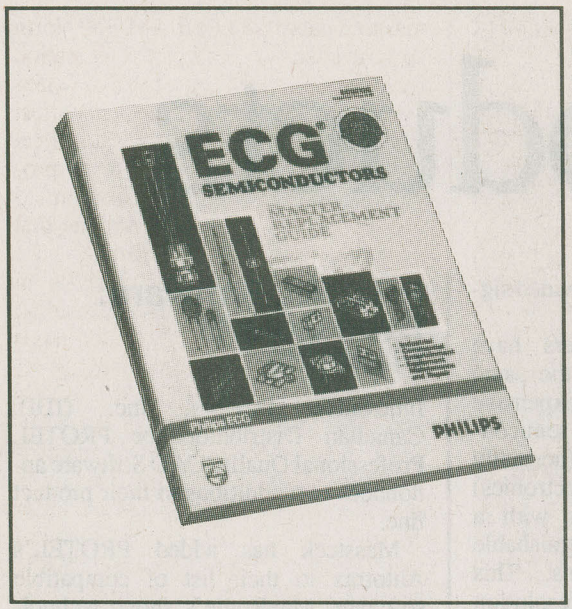
With this autorouting option available to designers, PROTEL now offers a choice with Autotrax. Autotrax can be purchased as Autotrax Non-extended (with netlist import, Auto Load, Manual Route DRC) and Autotrax Extended (includes full Auto Place and Autorouter).

All products are available in DOS and Mac versions with a full 30-day money back guarantee. Unlimited Technical Support and information regarding PROTEL software is provided free of charge during business hours and often beyond. Toll free for AB & BC (800) 661-2881. Outside of toll free and local customers: Innovative Devices, Inc., 1119 Damelart Way, Brentwood Bay, BC, V0S 1A0 or call (604) 652-5240.

Circle No. 19 on Reader Service Card

Philips ECG Introduces the 15th Edition ECG Semiconductor Master Replacement Guide

Montreal, Quebec — Philips ECG introduces its 15th Edition ECG Semiconductor Master Replacement Guide, No. ECG 212-Q, featuring over 21,000 additional cross-references and over 300 new devices, including new product families.



With more than 262,000 crosses to Industrial and Entertainment part numbers, the 15 Edition Guide is the most comprehensive single source of replacement information available to electronic equipment servicers. Expanded selector guides are also provided to simplify choosing the best ECG replacement type for numbers which are not crossed.

ECG has been supplying semiconductor replacement parts for 25 years. Today, the latest ECG Master Replacement Guide includes a total of approximately 4,000 components, making up the broadest available line of universal replacement semiconductors and accessories.

Some of the product categories with new products listed in the Guide include digital and linear integrated circuits, transistors, diodes and rectifiers, silicon controlled rectifiers, triacs, optoelectronics, IC protectors, and accessories.

Philips ECG products are distributed exclusively in Canada by ECG Canada, A Division of Philips Associated Holdings Inc. For the name of the ECG distributor nearest you, contact ECG Canada, 1928 St. Regis Blvd., Dorval, Québec H9P 1H6, Tel: (514) 685-5800, FAX: (514) 685-5804.

Circle No. 20 on Reader Service Card

Barcus-Berry Invents New Piano Technology

Huntington Beach, CA., — Pianists around the world will benefit from a dramatic breakthrough in piano pickup technology announced today.

Barcus-Berry, Inc., Huntington Beach, California-based musical instrument transducer pioneer, has developed a totally new type of sensor to solve all of the piano pickup problems that have long troubled sound engineers.

Called the Barcus-Berry planer wave piano system, it is available through retail music dealers worldwide.

According to Les Barcus, president of Barcus-Berry and inventor of the unique sensing device used in the new system, the piano is one of the most difficult musical instruments to record or to pick up for sound reinforcement. "After 25 years of research, I have found a simple solution to a very complex problem. Our planar wave system uses a single sensor attached to the piano soundboard. The signal can be fed to a wide range of equipment from large public address systems to cassette recorders," Barcus reported.

The sensing device measures about 2½-inches long, 1-inch high and only ½-inch wide. It can be installed on any piano in a matter of seconds. "This system is capable of enhancing the sound of all pianos. It can make a small upright sound like a grand piano and expand the sound of a concert grand to new dimensions. We have noted consistent improvements like increased dynamic range, faster response, remarkable tonal clarity in the top octave of the instrument and greater richness and depth of tone at the low end of the keyboard. The system also permits special effects devices like chorus, flanging and digital delay to be used, greatly increasing the overall versatility of any piano," Barcus added.

According to John Berry, executive vice president of Barcus-Berry, the potential market for the planar wave piano system amounts to millions of units worldwide. "It will be invaluable to churches, schools, nightclubs and piano bars, as well as to recording studios, video production facilities, theatres and concert halls. It also will be an important educational tool for piano teachers and their students," Berry noted.

"All professional musicians are familiar with the annoying feedback problems which commonly occur when traditional microphones are used with a piano for sound reinforcement. The new Barcus-Berry planar wave piano system virtually eliminates feedback even with the piano lid open at full stick. It also provides outstanding signal isolation, such as rejection of undesired ambient noise, and it assures consistent sound quality regardless of the acoustic environment in which the piano is situated," Berry stated.

"Our system truly represents a major advancement in transducer technology. The sensor detects planar wave energy at the surface of the soundboard while discriminating against flexural movement. This allows a single pickup to provide perfect, evenly-balanced response from one end of the keyboard to the other — an achievement never before possible," system inventor Barcus concluded.

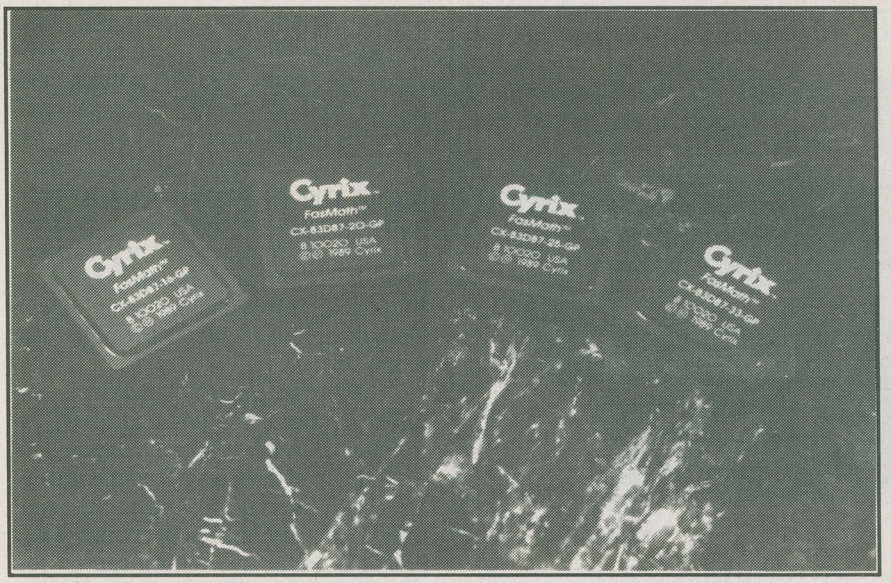
Established by Les Barcus and John Berry in 1964, Barcus-Berry is recognized worldwide as the leading designer and manufacturer of transducers, pickups and specialized microphones for musical instruments. It is the only company offering a complete line of dedicated systems embracing all traditional band and orchestral instruments, in addition to a full selection of pickups for both acoustic and solid-body electric guitars. These products, widely acknowledged as the professional standard for both recording and live performance applications, are used throughout the world by an impressive roster of artists, including many of the most respected names in the music and entertainment industry.

For information, contact John Berry, 5381 Production Drive, Huntington Beach, CA 92649.

Circle No. 21 on Reader Service Card

Cyrix Selects Two Firms To Market FasMath™ Coprocessors

Richardson, Texas — Cyrix Corporation today announced that Ingram Micro and MicroAge Computer Centers, Inc., will begin selling its family of FasMath™ high performance



numerics coprocessors immediately, including the newly introduced AutoMATH™. Both companies were added to Cyrix's distribution network in response to market and customer demands for the FasMath products.

"Cyrix offers high quality standard math coprocessors at low prices. During the past month, we received more requests for the Cyrix FasMath than for any other product which we were not currently marketing," said Victoria Cotten, director of purchasing for Ingram Micro. "Our Goal is to provide the broadest selection of high quality products in the industry. The addition of Cyrix's FasMath coprocessors enables us to give our customers the products they demand."

Both Ingram Micro and MicroAge Computer Centers cited strong customer demand as the reason for selecting the Cyrix products. Of the two companies, Ingram Micro will sell Cyrix FasMath products through distribution channels. MicroAge will market the coprocessors through its retail computer centers.

"We are continually seeking to expand the availability of the Cyrix FasMath products. The unique approach each of these companies brings to the market will guarantee the availability of FasMath through both distribution and retail channels," said Harold Schiffman, director of sales for Cyrix.

Cyrix Corporation was founded in 1988 to design, develop and market the broadest line of 32-bit math processors for desktop systems. The company announced the first FasMath processors in October in 1989, and in March 1990, introduced its low cost, low power family of SX products. FasMath processors are now in use in 25 countries worldwide. Cyrix Corporation, headquartered in Richardson, Texas is privately held.

Circle No. 22 on Reader Service Card

Built-In Database Revolutionizes Radio Tuning On The Road

New York, NY — The ID LOGIC circuitry contained in the CQ-ID90 car stereo tuner/cassette player from Panasonic has made that model one of the most successful radios of 1990 in terms of future trends.

"The CQ-ED90 has been performing so well that Panasonic is about to introduce a new ID LOGIC model, called the CQ-ID60, at an extremely attractive price," said Pierre Schwob, President of PRS Corporation, the developer and licensor of the ID LOGIC technology. The CQ-ID60 will also contain four amplifiers and will be a pull-out unit retailing around $350.00.

The ID LOGIC circuitry in the CQ-ID90 allows the user to select radio stations — even in unfamiliar cities — by format (classical, country, rock, jazz, easy listening or talk) simply by pressing the appropriately labelled button. In addition, the display shows the call letters of the station and the city in which it is licensed.

The technology is elegantly simple. Stored in a ROM computer chip is a massive database of all AM/FM North American stations organized by station format, call letters and city. So, whenever the user drives and the current host station begins to fade into the distance, the CQ-ID90 can be called on to provide a whole new roster of stations to choose from — including stations that match the user's selected format.

The ID LOGIC system contains an internal map of the U.S., Canadian provinces and bordering Mexican states in its memory. So, after having set his/her current location, if the user is driving from San Francisco to Los Angeles, he would let the system know where he is by pressing the East button and then the South button (the order doesn't matter) to cover the trip up until San Jose. The, after San Jose, he/she would simply touch the South and East buttons again every 50 miles or so until he reached Los Angeles.

Since radio stations may change their call letters or formats, ID LOGIC provides an extremely simple update facility to enter changes in the database.

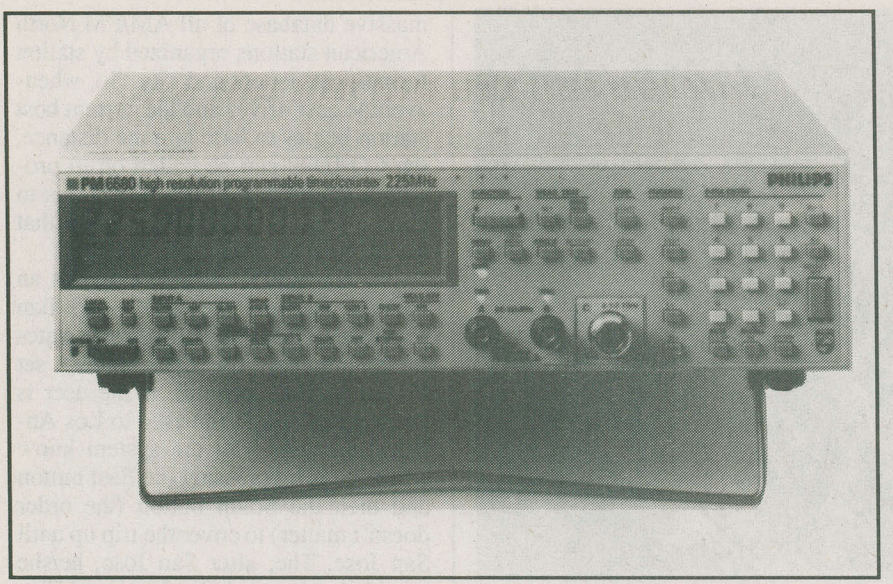
Of course, ID LOGIC allows radio receivers to be used the old-fashioned way — but even in this case, it will automatically identify all stations for unprecedented ease-of-use.

Circle No. 23 on Reader Service Card

Fluke PM 6680 Timer/Counter Offers More Measuring Power and Analysis Tools

Mississauga, Ont. — Fluke Electronics Canada Inc. announces its new model PM 6680 Timer/Counter. The PM 6680 expands the measuring power of traditional timer/counters, adds new time and frequency analysis tools usually associated with analyzers that cost much more, and offers several features.

Built-in Advanced Statistics and Mathematics Functions exceed the standard features included in timer/counters that cost at least twice the price. In addition to the usual scaling, mean, min/max, and standard deviation, the new PM 6680 includes more features such as inversion and measurement variables (current, previous and reference), which enable easier measurement of drift and rate of drift, for example.



High Speed Measurement with Internal Memory offers measurement rates to internal memory of up to 2,000 readings per second and 5,000 readings per second at reduced resolution. Coupled with the advanced math and statistics functions, the PM 6680 becomes a powerful tool for analyzing timing jitter (using a typical 1,000 measurements) without using a controller. Users can characterize VCOs or/frequency agile sources quickly and easily.

Unmatched Trigger Programming Flexibility offers more triggering flexibility than any time or frequency measuring device in the world. Arming can be delayed by a discrete number of events or by a selected time period with 100 ns resolution. That equates to a sampling rate of 10 MHz. This feature allows the PM 6680 to measure phenomena that previously could not be measured with any other instrument with 500 ps resolution.

The PM 6680 features a remarkably high 500 picosecond resolution for single-shot time intervals. Basic frequency range is 225 MHz, extendable to 2.7 GHz. Frequency measurements may be made with 9 digit per second resolution. In addition to the standard timer/counter functions, the new Fluke PM 6680 offers phase, duty factor and Vpeak measurements. And totalizing functions have been extended to include unique features such as simultaneous up/down counting, totalizing over a programmable time period, and cumulative totalizing of channel A gated by channel B. The new timer/counter also implements the IEEE-488.2 and SCPI standards.

The Fluke PM 6680 is available for $3,145 Canadian from Fluke Electronics Canada Inc., a leading supplier of electronic instrumentation and services designed to provide test solutions to technical users involved in research, manufacturing, service, design and calibration.

Circle No. 24 on Reader Service Card

Database of Practical Electronic Circuit Articles

Breslau, Ontario — Circuit Search announces the release of Version 1.09 of the Circuit Search database of references to articles containing practical electronic circuit designs.

This dBASE (R) III/dBASE III+ compatible database contains references to nearly 13,000 artilces and papers from over 300 technical and scientific journals and magazines. As an interdisciplinary reference source, circuits can be located by keywords from journals in fields as varied as electronics astronomy, agriculture, physics, chemistry, nuclear science, education, biomedicine, and many more disciplines where electronics can be applied.

The Circuit Search database is installed on hard disk on an IBM PC or compatible, and used in conjunction with either its own user-friendly menu-driven front end or a dBASE-compatible database management program. Practicla circuit references can be located by title, circuit description, device type(s) used (of great interest to designers), autor, author affiliation, journal, date, and more. The database occupies about 7 Mytes and comes on a series of diskettes that are installed and decompressed using a user-friendly menu-driven installation routine.

The Circuit Search database is ideal for electronics designers inclding engineers, technologists, educators, scientists and researchers, as well as libraries.

Additional services offered by Circuit Search include provision of hard copy (FAX or mail) of articles that qualify under Copyright Clearance Center (CCC) provisions (Circuit Search is a registered user), as well as update and revision services offered on a semi-annual basis. ❐

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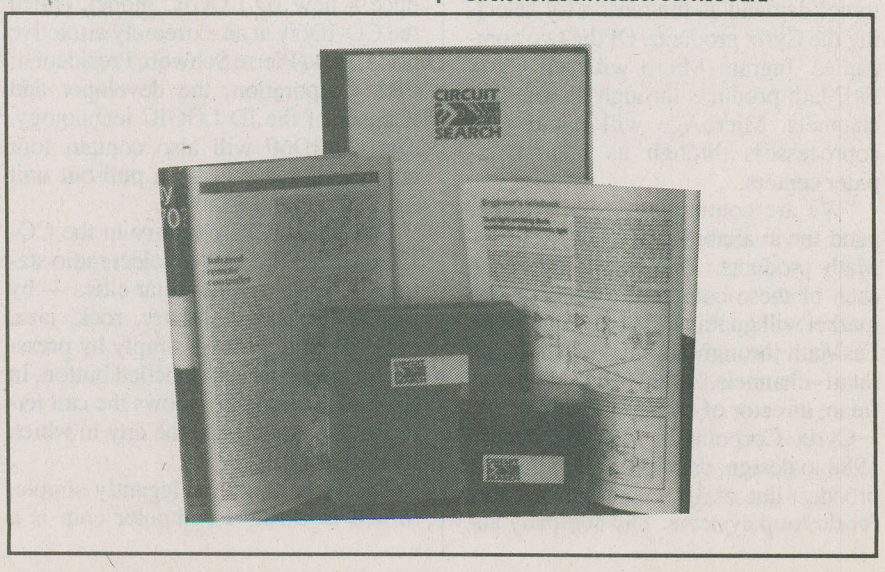


FEATURE

The Art & Science of Aerial Navigation

by Chuck Ander

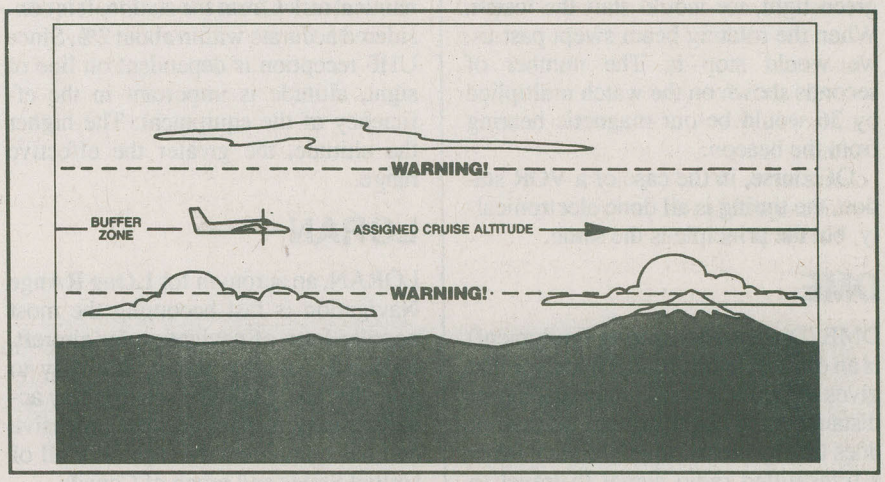
The first big step was to break the bounds of gravity and fly. Once that was out of the way, especially as aircraft became faster and flew farther and higher, it became increasingly important to know where we were going. As the old saying goes, "If you don't care where you are, you're not lost." If you do care, however, you're going to need some way of determining where you are and where you're going.

The first form of aerial navigation was most likely "dead reckoning." For this, you simply draw a line on a map and try to follow it, looking out the window for landmarks to confirm your position. However, electronic enthusiasts, never contented to leave well enough alone, came up with all sorts of new and improved methods of getting from point "A" to point "B."

VOR

The most common and widely used form of electronic navigation is called the "VOR" which stands for VHF Omnidirectional Range. The way it works it quite interesting. All over North America are hundreds of VOR ground stations, transmitting signals that, with the proper airborne receiving equipment, can be used for navigation.

The omnirange system functions in the static free VHF frequency band between 108.00 and 117.95 MHz. Each VOR station is assigned its own frequency.



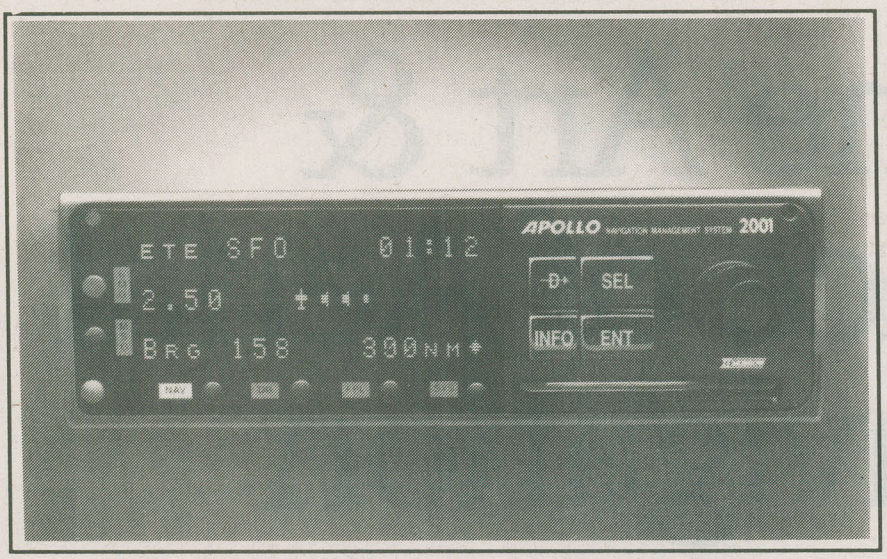
Altitude Control Using LORAN

Each station puts out two signals. The "reference phase" is non-directional. It has a constant phase throughout its 360° of azimuth. It is transmitted at a rate of 30 times a second. The other signal is called the "variable phase" and it rotates at a rate of 30 times per second.

The reference signal is timed to transmit at the instant the variable signal passes magnetic north. In all other directions, the variable signal will occur sometime later than the reference signal.

The principle of the omnirange is based on this phase difference between the two transmitted signals. By measuring the time it takes the rotating signal to sweep from north to where it reaches the receiving equipment in the airplane, it is possible to determine the bearing of the plane from the station.

This principle can be easily understood with an analogy. Imagine a rotating beacon of white light, such as might be emanating from a lighthouse. Let's say it is rotating clockwise at six rpm. This is one revolution every 10 seconds, or 36 degrees of azimuth per second. Suppose a green light was timed to flash every time the rotating beacon swept



APOLLO NMS (Navigation Management System) by II Morrow

past magnetic north. So if we had a stopwatch, we could determine our direction. When we saw the flash of the green light, we would start the watch. When the rotating beam swept past us, we would stop it. The number of seconds shown on the watch multiplied by 36 would be our magnetic bearing from the beacon.

Of course, in the case of a VOR station, the timing is all done electronically, but the principle is the same.

DME

DME (Distance Measuring Equipment) is an electronic transmitter/receiver that gives the pilot a continuous reading of distance to a fixed ground station. It does this by measuring the time it takes a transmitted radio signal to travel to and return from the ground station. The Airborne equipment transmits pulses to the ground station that, in effect, ask, "How far am I from your station?". Each aircraft "interrogation" has a unique transmission rate or pattern which the ground station reproduces in its replies to an individual aircraft even though transmitting on the same frequency to all aircraft working the station.

DME units also have the capability to give ground speed and a time to station reading. DME operates in the 960 to 1215 MHz UHF range.

DME channels are paired with VOR channels so that, when the pilot chooses on his DME equipment a VOR channel, he automatically chooses the UHF frequency as well.

DME is considered reliable up to 200 nautical miles from the station. It is considered accurate within about 2%. Since UHF reception is dependent on line of sight, altitude is important in the efficiency of the equipment. The higher the altitude, the greater the effective range.

LORAN

LORAN, an acronym for **LO**ng **RA**nge Navigation is fast becoming the most popular form of navigation for aircraft, especially smaller planes. It's easy to see why, too. LORAN is extremely accurate, easy to use, not too expensive and has complete coverage over all of United States and much of Canada.

LORAN is a ground-based navigation system relying on a series of transmitters, transmitting pulses with a carrier frequency of 100 kHz. Since this band of low frequencies (LF) follows the curvature of the earth, the signals are effective over great distances. These signals are also reflected by the ionosphere (called sky waves). LORAN receivers are made to reject these sky waves since varying atmospheric conditions make these waves unreliable for determining position.

The transmitters are set up in groups called "chains" which provide signal coverage for a certain geographical area. Each LORAN chain is comprised of one master station, and from two to five secondary stations. Each chain is assigned a unique time sequence code called a Group Repetition Interval (GRI). The GRI is the time between the start of the master station transmitted pulse, and the start of the next master station pulse.

The master station transmits a pulse group, and then each secondary station transmits its group of pulses after a precisely predetermined time interval called a "coding delay." A coding delay is the time from the start of the master pulse group to the start of each secondary pulse group. Each secondary station within a chain is assigned its own separate coding delay.

The LORAN receiver is a combination radio receiver, precision timer, and calculator. The LORAN system is based upon time measurement. Radio waves travel at the speed of light. The LORAN receiver measures the precise time difference (TD) between the pulse groups in a GRI (Group Repetition In-

see **Navigation,** *page 15*

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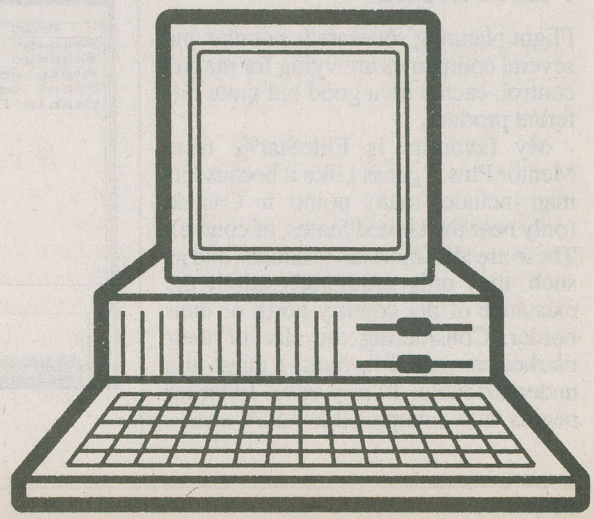
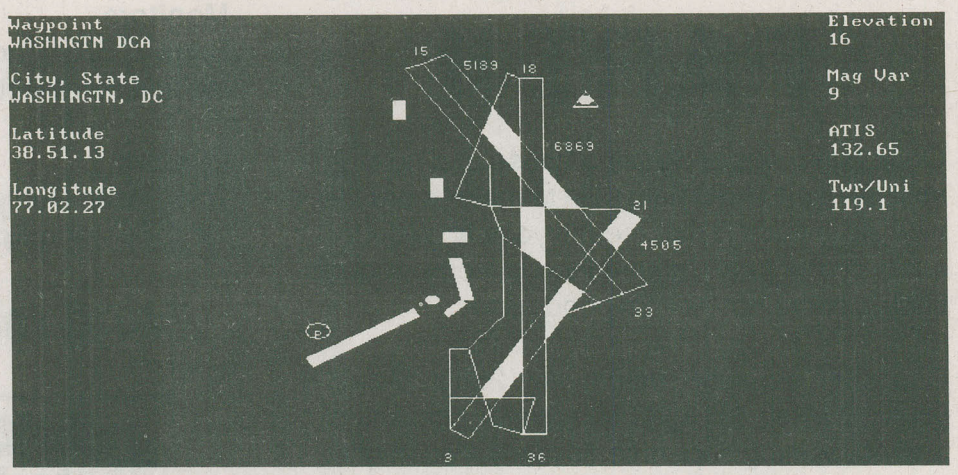


FEATURE

Computers in Aviation

by Chuck Ander

The most common and most popular use of computers in aviation must be simulators. There are numerous games on the market designed to simulate fighters, and some of them are quite good. However, the most popular simulator is Microsoft Flight Simulator. There are even whole Societies and groups set up to support the users of this popular software program. And it's quite good! You can design your own scenery, your own aircraft — and you can even (with a great deal of design work) fly over your own house!



FlightSoft Pro Graphic Screen (Washington D.C Airport)

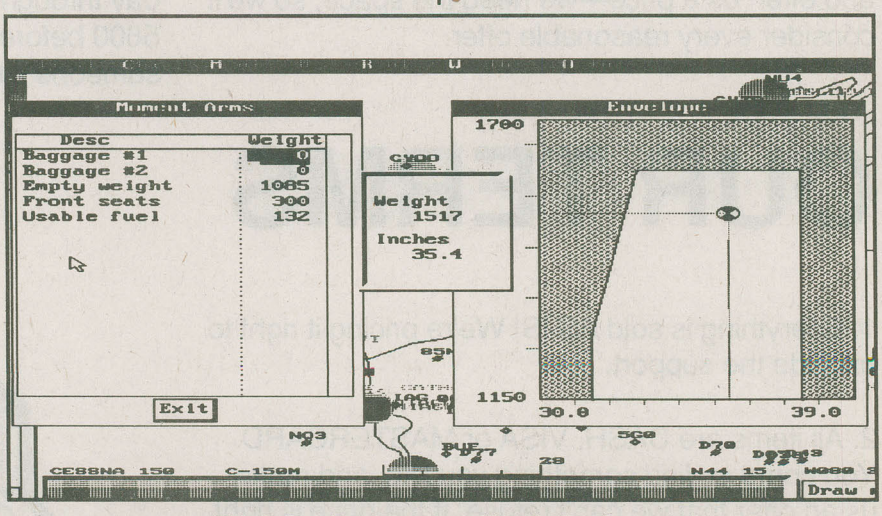
But as far as Microsoft Flight Simulator being a useful aviation tool, that is open to debate. But the program is fun — and that's a fact.

Azure Soft puts out a much more complex simulator called Elite. It is billed as being a useful tool for pilot instrument training. Unfortunately, I was not able to obtain a copy for evaluation.

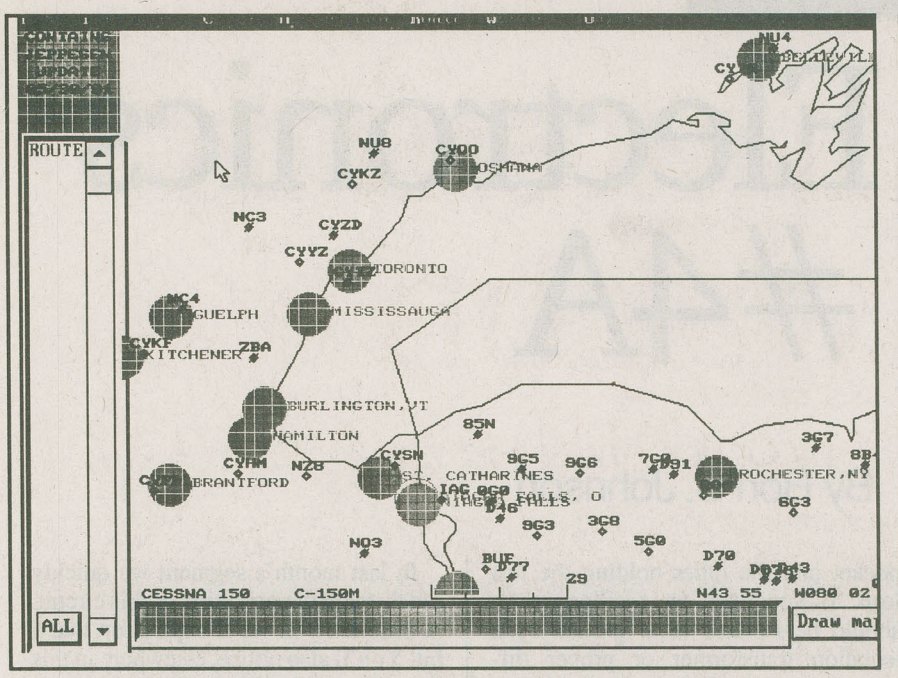
Plan Ahead

Flight planning software is popular and several companies are vying for market control, each with a good but quite different product.

My favourite is FliteStar‰ from Mentor Plus. I guess I like it because its map includes many points in Canada (only near the United States, of course). These are all American products, and as such, they only grudgingly admit the existence of big country north of their border. Considering the size of their market compared to ours, I guess it's understandable. In any case, FliteStar begins with a map of the U.S.A. showing cities, airports and VORs, etc. What's I really like, is that you can block out a smaller area of the map with the mouse and that area instantly expands to fill the entire screen, showing great detail in the process. All the tools needed to plan a flight are available including weight & balance, performance data (including influence of winds) and a great "what if" performance evaluator for your aircraft. Its features are too numerous and exten-



FlightStar Performance Simulation Screen



FliteStar Map Screen (Showing Eastern Lake Ontario Area)

sive to explain in detail in this article. Suffice to say that they are extremely useful and take full advantage of computer graphics.

George™ from Azure Soft is another excellent flight planner. It is also graphical and extremely useful but not quite as intuitive as FliteStar. It contains all the features you need for effective flight planning.

FLITESOFT™ from RMS Technology, Inc. is a low priced but excellent flight planner. It has the advantage over the others that you can use any monitor — even a lowly Hercules compatible monochrome. FLITESOFT is what I would call "waypoint driven." That is you first enter a starting airport and then your first destination airport. It has a text based screen to start but graphical functions are available from the menu at the top of the program. The map is not as detailed as the other programs mentioned, but FLITESOFT has one feature they don't have — a graphical representation of some airports, showing the runway layout and other features. I only wish more airports were represented in this way. As I understand, they are enlarging their airport database, as are the other programs mentioned.

All these programs make full use of the computer and its associated graphics. They take what would be extremely laborious tasks and automate them, making them fun to use and useful as well. ❐

Navigation, *Cont'd. from page 12*

terval) and processes the information to determine a position fix.

LORAN receivers are position determining devices, and all data is calculated from constant updating of position fixes.

The LORAN receiver monitors the signals from all stations within the selected chain. It then measures the Time Difference (TD) between the reception of the master signal and a secondary signal to determine a single Line Of Position (LOP). This same process is then repeated for each available secondary station in the GRI to determine an approximate position. Most receivers then choose the best triad (the master and two secondary stations) to provide an accurate position fix. This information is usually converted into latitude/longitude coordinates. Most LORANs contain databases of airports as well.

Inertial Navigation

Inertial navigation is really unique because it is self-contained. No transmitters are necessary for its operation. The principle behind this system is that if you can accurately measure acceleration, you can perform a mathematical function called integration on it to obtain velocity and you can integrate velocity to obtain position. Here we are dealing with vectors — units of measurement containing both magnitude and direction. Since you need three coordinates to accurately fix an object's position in space, you must measure acceleration in three planes.

Don't Step on the Accelerometer

An accelerometer (not to be confused with an accelerator) is a device to accurately measure acceleration. Imagine a pendulum hanging from the roof of your car. If the car is stopped or is going at a constant speed in a straight line, the pendulum hangs straight down. If the car starts moving or if it slows down, or if it turns a corner, in other words, if it accelerates, the pendulum will move. This movement, when measured, is directly proportional to the acceleration of the car. An accelerometer works in a similar manner.

So to measure acceleration in three dimensions, you need three accelerometers, measuring the acceleration vector in three planes. These accelerometers are mounted on a stable platform, kept in the same plane by gyroscopes. The information from the accelerometers is fed to an on-board computer which integrates the acceleration vector to give a velocity vector. This in turn is integrated to give a position vector.

Therefore, all you have to do is tell the inertial navigation system where you are at the beginning of a trip (by dialling in the longitude and latitude) and it will tell you where you're going, how fast you're going, your position and when you're going to get where you're going. By tying the unit into an autopilot, it will even fly the plane for you! Too bad they sell for about $200,000 each.

There are many more types of navigation systems. I've mentioned only a few. But hopefully, this will give you an idea of what's been done and what's possible. ❐

FEATURE

Basic Electronics #4A

By Ron C. Johnson

Get out your drill, pliers and soldering iron. This time around we're building the speed control circuit I showed you in last month's segment. Actually you'll need the drill for more than putting holes in the chassis and printed circuit board because, when you're done here you will have a speed control which will turn that single speed drill into a variable speed model.

The accompanying photograph shows my version of the speed control in a small aluminum box about 6 cm by 8 cm by 13 cm. You just plug the drill into the AC socket on the top and plug the AC power cord from the box into the wall outlet. In this article we'll take the schematic of the speed control, convert it into a printed circuit board layout and assemble the parts into a working prototype. In the process, we'll look at several ways to make printed circuit boards: how to generate the artwork, and how to eventually get the pattern you designed onto a copper clad board.

Before we start into any part of this project an important warning must be made: **BE CAREFUL...** This project involves building and testing a circuit which connects directly to the 115 volt AC power line. **THIS IS A DANGEROUS VOLTAGE!**. Disconnect the circuit from the AC power before soldering or touching the circuit board or components. If you must test the board while it is powered up make sure that no part of your body comes in contact with the circuit. A good rule of thumb is to test with one hand in your pocket and the other holding the test lead. If you have an oscilloscope it should be isolated from ground by a isolation transformer or proper differential measurement techniques must be used. **DON'T TAKE ANY CHANCES!** (I don't want to hear about any readers going up in smoke... It's bad for the magazine's circulation, not to mention yours!)

First order of business: I must apologize for an error in the schematic diagram of the motor speed control shown in the last segment. The connections to the bridge rectifier were shown incorrectly. Figure 1 shows the correct version in addition to a couple of other changes in circuit components which I found necessary (or expedient) when I constructed the circuit.

In last month's segment we quickly ran through the operation of this circuit. A little later on we'll expand on that a bit. You'll also notice, elsewhere in this article, a sidebar where I discuss the steps you should follow in the development of any project.

Okay, the construction details of this project:

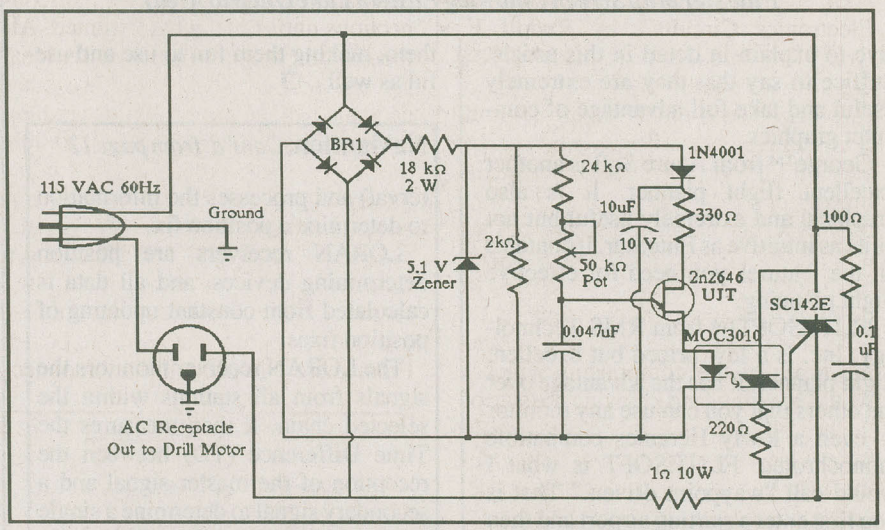


Figure 1. Variable Motor Speed Control Schematic with Corrections

Construction

Ideally, a speed control for an electric drill should be built into the drill itself, as it is in the commercially available variable speed drills. However, I didn't think this was feasible, and even if it was possible to fit the circuit inside your drill it probably would not be safe. The next best situation was to have a

small box, (the one I used was larger than necessary), with a speed control adjustment mounted on it, in line with the drill. After finding a suitable aluminum box at Radio Shack I knew what the maximum dimensions of my circuit board should be. I mounted the speed control potentiometer into the top, the AC line cord into one end and an AC outlet (chassis type) into the other end. Having done all this I could see what size to make the board and how I should position it to avoid any problems fitting the external wiring into the box.

From this point I could start the process of converting the schematic into a working prototype. As always, the first step was to breadboard the circuit in order to test it and work out any 'bugs'.

I should confess that this circuit is not my own design, but one I found in a book called "The Encyclopedia of Electronics Circuits", by Rudolf F. Graf. This book is published by Tab Books and contains over 1300 circuits categorized into ninety-eight sections. It is relatively inexpensive and can be very useful for finding circuit ideas and innovations. Anyway, the circuit from this book, (as usual), required a couple of initial modifications to get it working on the breadboard. The next step was to design a printed circuit board layout.

I knew the physical sizes and mounting types of the components which I would be using, and knowing the size of the box all of this would go into I could lay out my circuit board. One way to do this is to lay out the actual components, or paper cut outs of the components, onto a piece of paper the size of the final board, rearranging them until you obtain a satisfactory design. Next you draw in the locations of the pads which the component leads will be soldered to and interconnect them. Use pencil because it will probably take a few attempts and rearrangements before you get it right. With a board of this complexity you won't need to use jumpers (to jump over tracks to make connection to another part of the board), but this can happen with more complex boards.

In my case I used a drawing program on my computer (PC Paintbrush IV) to do the same thing. First, I made up drawings of each component I would use, and then, using the gadget box I moved them around into the positions I wanted. (See Figure 2). Next I drew in pads and experimented with interconnections until I had what I wanted. Although this program is not really ideal for this sort of work (there are other dedicated PC board design programs), it wasn't too difficult to adapt it for this purpose. I then took this initial component layout and got rid of the components themselves while leaving the pads and lines in place. Next I used a function of the program to flip the layout so that I was looking at the bottom view, or solder side of the board. From there I re-drew the interconnections as wider traces (Figure 3) and finally inverted the whole thing so it looked like a negative (Figure 4).

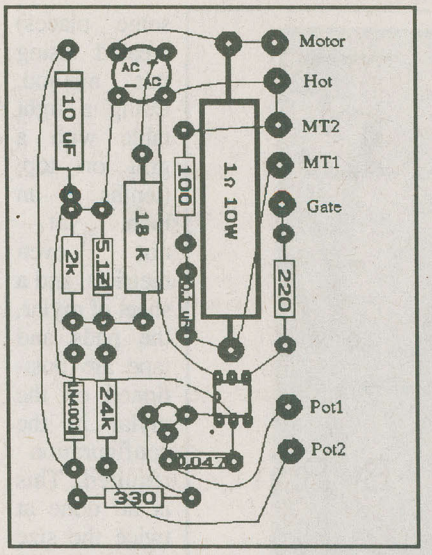


Figure 2. Component Side of PC

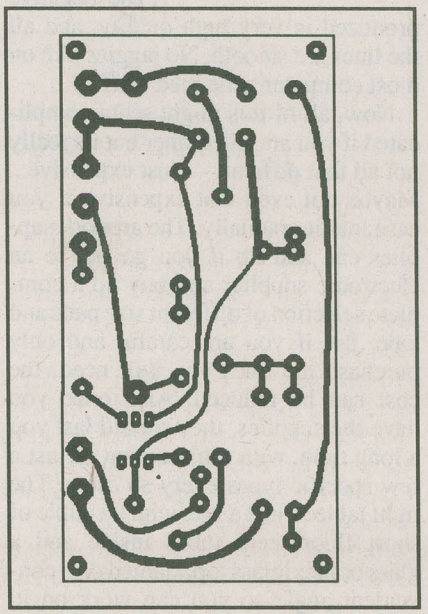


Figure 3. Solder Side of PC Board

This gave me a design for the board layout but, as we'll see shortly, I took a different route to actually generate the printed circuit board.

Circuits As Art

Although this circuit is not extremely complex I wanted to make a circuit board photographically rather than using the crude resist pen method to draw the traces on the copper clad board. There are several ways to make PC boards. If you are using a negative photoresist process you must generate a photographic negative in which the copper traces are transparent. If you are using a positive type process the negative must have everything *but* the copper traces transparent. Either way, you have to generate a high quality negative of the solder side layout which can be used in the photographic board etching process. First let's talk about various ways to get the artwork used in making a negative.

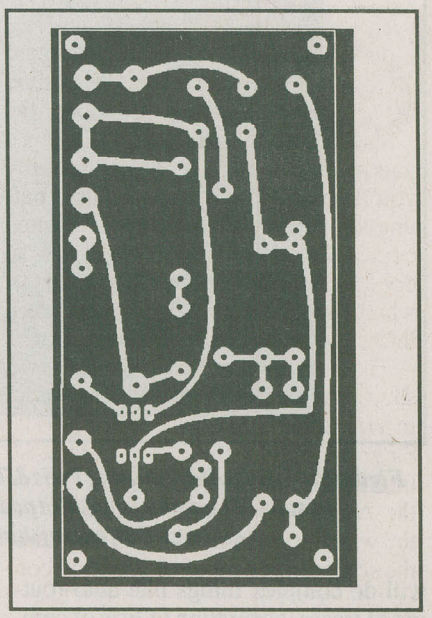


Figure 4. Negative of Printed Circuit

As I mentioned, the ideal method for generating artwork for PC boards these days is, not surprisingly, with a computer. There are all kinds of specialty software packages, such as Tango or Orcad, which not only allow you to lay out the pads and traces on screen, but

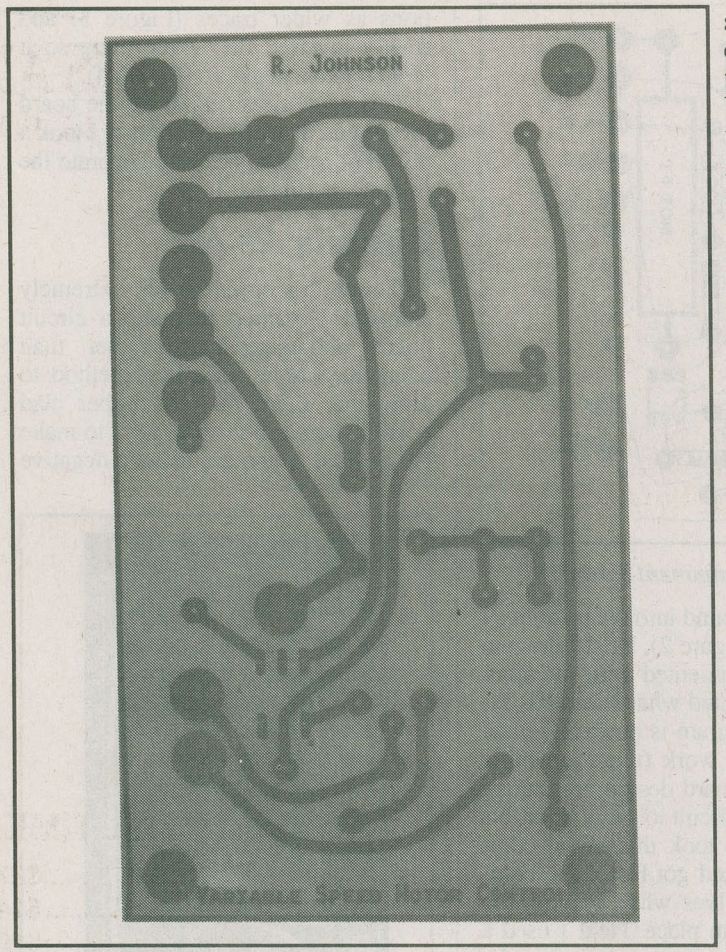


Figure 5. PC Board layout using Pads & Tape. (This layout contains a mistake. The second and third pads at top left should be connected instead of third & fourth).

will do complex things like auto-routing of traces, generation of lists of components, and lots of other goodies. Once you have the layout in memory you can print it out, either using a plotter, or a laser printer, which can then be used to make the negative. Although I had a layout, produced with my drawing program, I decided to use a different method to produce my negative for two reasons: First, I encountered some difficulties in getting a high quality, correctly sized print out of the Paintbrush drawing I created. Second, I wanted to show you how it could be done with out needing a computer.

As for those computer circuit design programs... a future article, perhaps...

So how did I do it?

I went back to the old, tried and true method using double size tape and pads. For years, professionally printed circuit boards were (and probably still are in some places) created using this method. Using a light table with a grid on top, (tenths of an inch, yet — not even metric!), and a sheet of mylar, the pads and tape are positioned on the mylar in the configuration required. This is all done at twice the size the board will eventually be (sometimes at four times the size for complex boards). When the artwork is finished, it is taken to a specialty photographic shop where they produce a negative of the artwork at half its original size. (The negative produced is very high quality, and all the lines are smooth. No jaggies like on most computer generated stuff...)

Now, all of this might seem complicated if you are a beginner but its really not all that difficult — just expensive... Maybe not even that expensive if you ease into it gradually. The artwork supplies can add up if you go out to an electronic supplier and buy up a complete selection of different size pads and tape, but if you are careful and only purchase the ones you will need, the cost can be reduced. Also once you have the supplies, they should last you a long time, with replacement of just a few specific types every so often. The light table is just a box with a couple of short fluorescent tubes inside and a glass or plexiglass top, slanted on a convenient angle so you can work on it. You can easily build one if you decide to go this route. (All in all, though, you can see why the computer generated artwork approach is better if you have hardware already. Software may cost you anywhere from one hundred dollars, for something basic, up to several thousand, for the high tech programs, but once you have it you can do a lot with it.)

As for the photographic reduction... just look in the yellow pages under graphics or photographics and phone around. You will eventually find someone who can do the job. For a negative the size of the board in this project it cost me about five bucks, (plus the GST, of course, which some people say stands for... no, I won't repeat it), but I got a deal. It might cost you anywhere up to twenty from a commercial shop.

So I laid out my artwork, (see Figure 5), had a negative made and then used the negative to produce a board. (Figure 6) I should mention here that (blush) I

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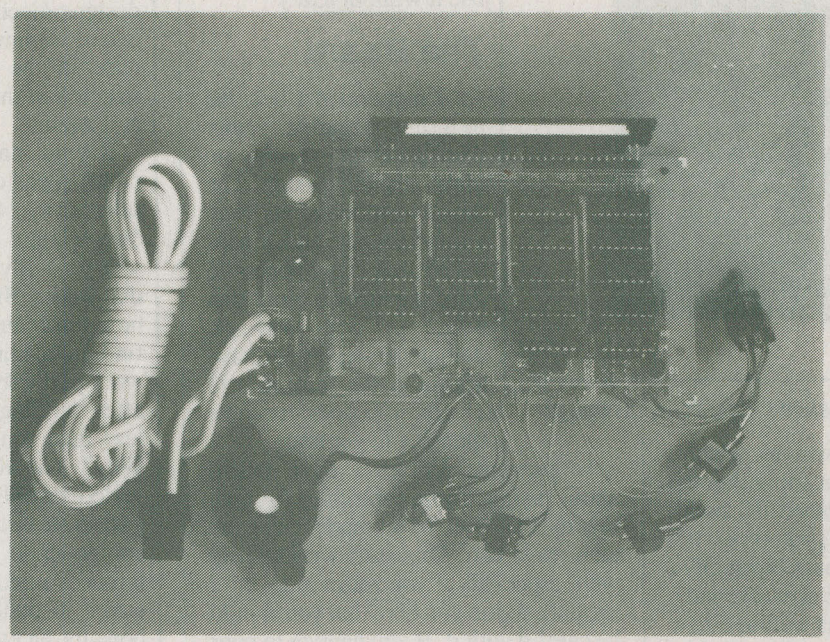

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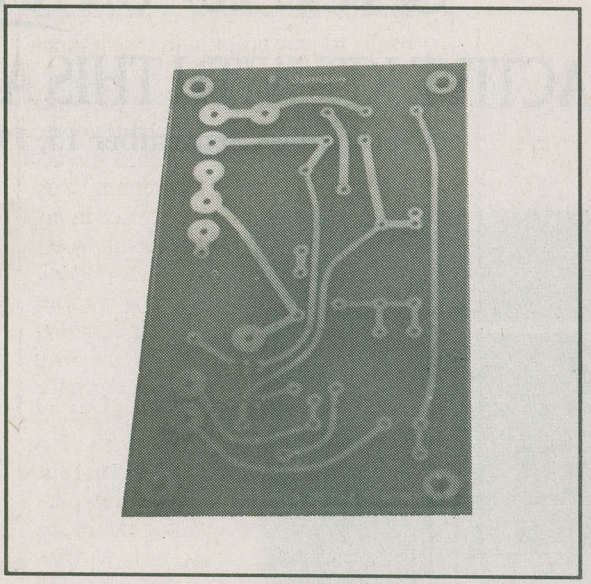

Figure 6. The Finished Printed Circuit Board

made a mistake on the artwork which I did not notice until I was mounting the components on the finished PC board (see the sidebar about prototypes not being the finished product). Normally I should have re-taped the artwork, had a new negative made up as well as a new PC board - but I didn't... The mistake was easily corrected by cutting one track and soldering in a jumper on another, so that's what I did. (Figure 7) (By the way, Figure 3 shows the artwork with the correction made so you can use it without fear.)

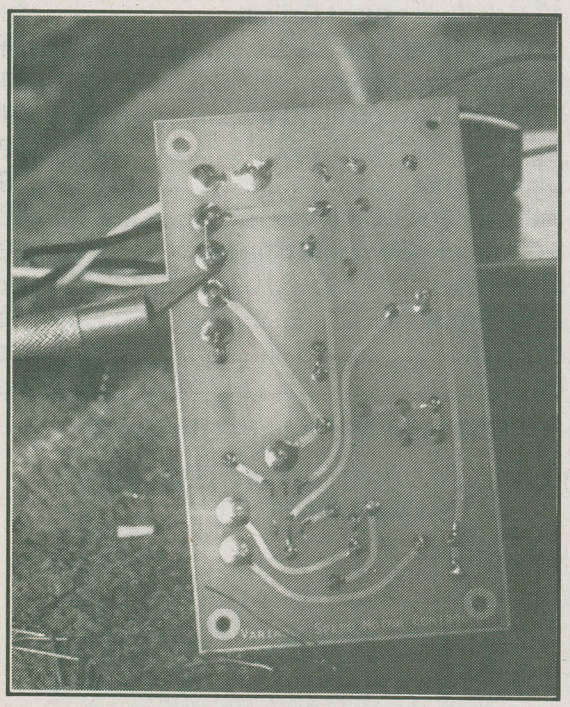

Figure 7. Solder Side of the PC Board with Components Soldered in. (The knife shows the track that was cut. Directly above, a jumper was soldered in.

The Board

As I mentioned I decided to use a negative, rather than positive, process to make my PC board. The negative process has been around longer, and it happened that I had access to the equipment to do it that way. As with artwork, though, if you do not have access to the resources to etch circuit boards, it can be expensive to get into.

In previous articles I have talked about using ferric chloride to etch boards that you have made using an etch resist pen. This stuff works fairly well, especially if you warm it up, but I should caution you here that you should be careful with it. If you happen to pour it down a drain it can eat right through the drain pipes. (I probably don't need to suggest how bad this is for the environment in general.) If you do use it, and dispose of it this way, make sure that it is well flushed out and diluted by a quantity of water. (It is soluble.) A better solution might be to find an alternate disposal method. Check with your local municipal government or an environmental group; they should know the details.

Back to the PC board...

It isn't the etchant that is the expensive or difficult part of getting from the negative to finished board. In order to use the negative to transfer the layout onto the copper clad board you must first sensitize the board to light. One way to do this is to use liquid photoresist. This is the old method where photoresist is poured onto the copper clad board and spread around into a thin layer using a

About Projects

Let's talk about the process involved in putting together this project. Even though the level of complexity of the circuit is relatively simple, the design procedure is similar. To some extent we have followed this procedure in the simpler circuits constructed in this series, but let's look at it again.

If your main desire is to build a motor speed control and you use the schematic, component values, and circuit board layout shown here you will probably end up with a project that works. But, let's be honest here: how many times does a circuit you find in a magazine, or elsewhere, work perfectly when you power it up after building it. In my experience: less than ten percent of the time. Why? The reasons are many and varied: errors in the schematic (like I gave you last month), variations in components and tolerances, differences in construction techniques, errors in construction, faulty components, etcetera...

But then, it wouldn't be any fun if everything worked perfectly the first time...

So what about this process? In electronics, as in other scientific and engineering oriented fields, projects are often organized in phases. The first phase, after deciding what it is you want to build, is to decide what your specific needs or requirements are. For example, in the motor speed control we ask ourselves: "What kind of a motor do we want to control? Do we want to control all the way from zero RPM to maximum RPM? What are the electrical requirements of drill we will control? Physically, how large and what shape should the speed control be? What are the cost considerations? What about parts availability?" The list could go on, and some of your answers may be different than mine.

After deciding on your requirements you go to the design phase. In this case you may just capitalize on the work I have done in designing the prototype, or, you may want make the circuit physically smaller, or able to drive a larger motor. Often, during the design phase, you will go

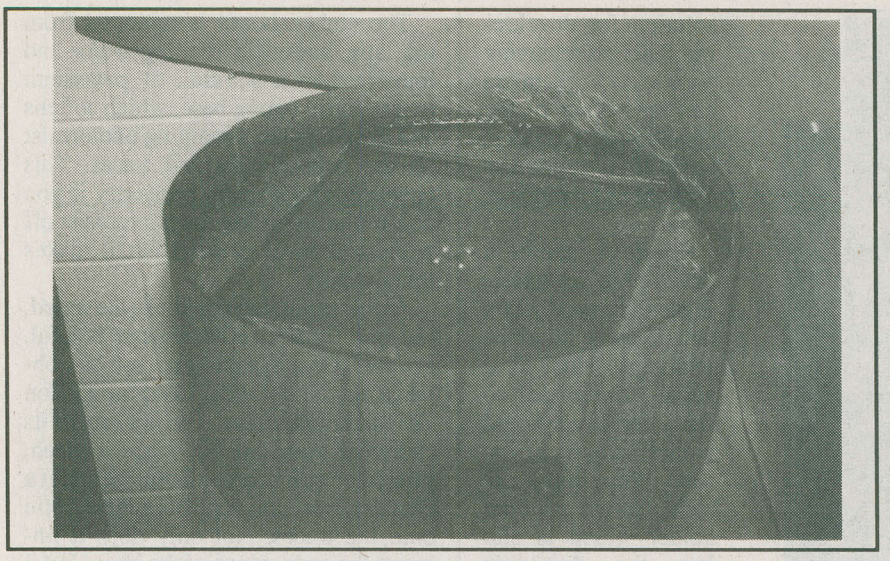

Figure 8. A Spinner Used to Spread Photoresist
Photo courtesy of Northern Alberta Institute of Technology (NAIT) Electronics.

centrifugal spinner. (Incidentally, before any kind of photoresist can be applied, the copper clad board must be cleaned of all oxidization using steel wool or sand and a scouring pad.) Figure 8 shows one of these spinners with a build-up of photoresist around the edge. The photoresist itself is quite toxic, requiring careful handling and good ventilation. A spray-on type is also available, with the same drawbacks. Also, both types are expensive. Another way to go is to buy pre-sensitized boards wrapped in black, opaque plastic which avoids the need to handle chemicals. These too, can be expensive. It should be noted that all of these supplies are available from electronic suppliers such as Cardinal Electronics or Electrosonic.

Another way, newer, and the way I chose to do it, is called a dry laminate process. In this process a special, dry film is laminated onto a clean, deoxidized copper clad board using a special laminator. The dry laminate is light sensitive, similar to photoresist but is easier and safer to handle. The procedure for developing is slightly different than for photoresist and uses safer chemicals as well. With dry laminate photoresist, as with the liquid, once the photoresist is on the board the areas which you want to remain on the board

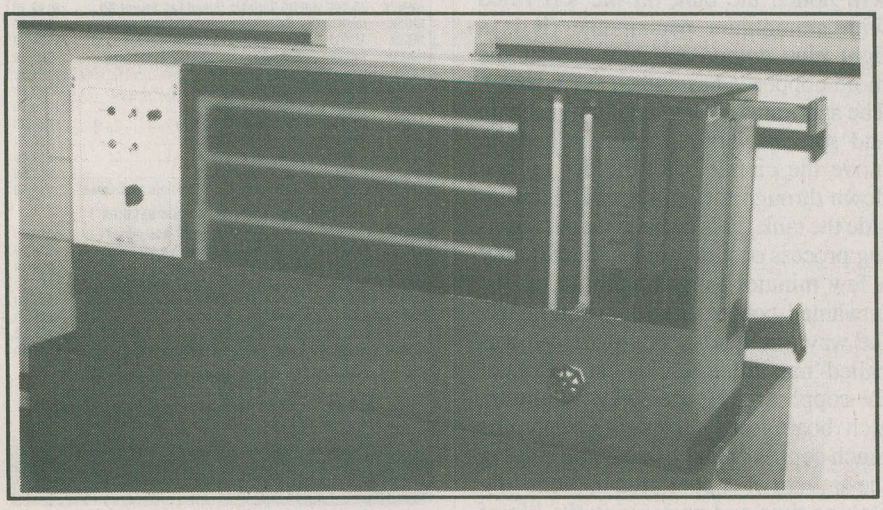

Figure 9. A Developing Unit

back to examine and sometimes change your requirements.

Once you have a design on paper it is highly recommended that you go to a breadboard stage before you actually try to build the circuit. You may have supreme confidence in my design - and I humbly thank you - but, still, I suggest that you breadboard the circuit first, for the reasons mentioned earlier. Breadboarding allows you to try the circuit with actual components and to make quick modifications, if necessary. When you are satisfied that the circuit will work, you can then use the same components in the prototype.

I used the word 'prototype' in the last paragraph purposely. After breadboarding the circuit, you will design (or use my design) and fabricate a printed circuit board to mount and interconnect the components as on the breadboard. We often hope that this first circuit board with operate satisfactorily, but unfortunately, all too often problem arise, even at this stage. That is why we call it a prototype. The circuit is a one of a kind, test run, which will prove whether or not the design will work in this final form. If it does, great! If not we may have to make further modifications to it. In the case of a home project you may be satisfied to make the modifications required by some sort of 'kluge' repair to the board: adding components or cutting tracks and adding wires. Of course, in a professional or manufacturing environment, the design would be reworked and subsequent prototypes would be constructed until a finished product was obtained. (The truth is that I've worked in manufacturing and it's surprising how often products come out with post-manufacturing fixes added to them.)

I've already alluded to the final step in the process which is that of testing. Once the prototype is build it should be tested against the criterion established back in the first step. The questions must be answered: Does this thing really do what I wanted it to do in the first place? Does it look right? Is it safe? Did the cost fall

see **Projects**, *Cont'd. on page 23*

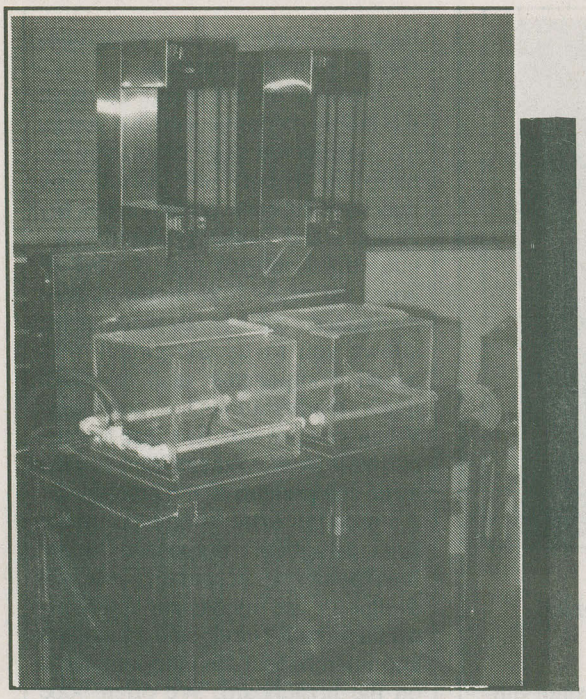

Figure 10. An Etching Tank Using Ammonium Persupphate.

as pads and traces must be exposed to a bright ultraviolet light. This is where your negative comes in: The negative is placed over the sensitized board and exposed to the ultraviolet light. Special UV fluorescents can be used, and I have heard that even direct sunlight will do the job if the board is exposed long enough.

The light I used was a zenon type light in a special flip-top exposure table. This unit uses vacuum to hold the negative firmly in place against the PC board. First the board and negative are placed on the table and the glass is lowered over them. Next, the vacuum is turned on, which pulls the negative down hard against the PC board. The whole top of the unit pivots and is turned over so that the board and negative face down at the light which is then turned on. A timer shuts the light off in about three minutes.

Now that the board has been exposed it must be developed like a photograph. Developing the board basically hardens the photoresist in the areas where it was exposed to light making it impervious to the etchant used later. With the old type of photoresist the chemicals used for developing were pretty strong. Another advantage of the dry laminate process is that it uses sodium carbonate solution for developing. This is a relatively harmless chemical and the results of the developing process are at least as good as with the older process.

Figure 9 shows a developing machine. Basically this is just a tank that is plumbed with pipes which have spray nozzles set to spray the entire board with developer. In this case the board is clamped into a sliding holder which is slid into the developer from the side. A separate chamber is used to wash the developer off the board with water before removing it from the machine.

After the board is developed it is ready to be etched. The etchant used in this particular system was ammonium persulphate. We talked about the disadvantages of ferric chloride before. Ammonium persulphate has some real advantages: Although it is also heated to improve its speed of etching it will etch at room temperature (albeit slowly). It is also more environmentally friendly and doesn't attack metals quite as violently as ferric chloride. The etching tank shown in Figure 10 is a dual unit. You will notice the tank on the left filled with ammonium persulphate (it is a light blue colour and gets darker the more copper it has etched off boards). The apparatus on top, including a chain and sprocket arrangement, is used to move the circuit board holder up and down through the sprays of etchant inside the tank. This ensures that the etching process occurs evenly. It takes only a few minutes to etch away all of the unwanted copper from the board. (By the way, the type of board we did was called 'maximum etch' because most of the copper was etched away. Minimum etch boards are designed to leave as much copper on as possible minimizing the amount of copper used up, reducing etching time and prolonging the life of the etchant.)

The etched board is removed from the tank, rinsed in running water and immersed in a solution of potassium hydroxide, a strong base, which softens and dissolves the remaining photoresist on the copper pads and traces. This chemical is not really necessary if you don't mind scouring the photoresist off with steel wool or sand but it makes things easier.

At this point you could use the board, but one further refinement is helpful. From electronic suppliers, you can obtain a chemical called 'Cold Immersion Tin Plating Solution'. I'm not sure of its chemical make-up but when a clean, printed circuit board is immersed in it a chemical reaction deposits a layer of tin onto the traces. Not only does it improve the appearance of the board but it inhibits any oxidization of the copper which would make it difficult to solder to later.

Fig. 11. The Completed Project

After a couple of minutes of tinning the PC board can be trimmed and drilled. Drill bits for electronic component leads are very small and must be purchased at electronic suppliers or specialty tool suppliers. A Dremel type tool, especially with a press attachment, is useful here as alignment can be difficult and tiring after a few dozen holes.

Well, there we have the PC board manufacturing process. Hopefully, it was of some interest to you. I suspect, however, that considering the costs, and the amount you might use it, you may not rush right out and set up your own circuit board manufacturing facility. However, as a hobbyist you will still want to make PC boards. Let me suggest a couple of things: try to find an individual or company who has all this stuff and will let you use it from time to time. Often, a friend who has access to this kind of equipment could get the use of it on weekends or evening at little or no cost to you. Alternately, find a local manufacturer of PC boards who will make the board from the negative. I found one small company, operated by one person out of his basement, who would make up one board at a time, trim, drill, plate, etcetera for fairly reasonable prices. If you do decide to set up your own facility, start small, and above all be careful. Make sure that ventilation is good and storage is adequate to keep chemicals safely out of reach of children and those not familiar with their use.

Let's continue and look at how the printed circuit board is used in the rest of the project.

Stuffing The Board

As I mentioned, I made a mistake on the layout of the board. When I finally noticed this I used a scalpel type knife to cut the unwanted track and then soldered in a jumper in the right place. Although not too cool, it was effective and cheaper than starting over. (Who says I'm tight?) Next I installed the components onto the board, forming the leads with needle-nose pliers. I mention this because it is a frustrating way to form leads, usually resulting in oddly shaped leads and a generally messy board. There are a couple of lead bending tools on the market which, though made out of cheap plastic, work very well. But don't be fooled by the material they are made of: they will still cost you more than a family outing at the Golden Arches.

Circuit Operation

Referring back to the schematic in Figure 1, a couple of things should be pointed out. First, the power triac: The original number of the part used in last month's article was a 2N6347, a standard 15 Amp triac. I replaced it with an SC142E, which is a 10 Amp version (more than enough for this application) in a TO-220 package with an *isolated tab*. This is important. Although it is possible, even probable in retrospect, that the triac need not be chassis mounted for heat dissipation at all, I did it anyway. But I was concerned that, unless very good quality isolation was obtained using insulating hardware, a shock hazard might exist. To avoid any problem I chose a triac with an isolated tab so that no circuit voltages would be present on the tab which is bolted to the chassis. I also made sure that the third prong ground wire from the AC line cord was securely connected to the chassis. This ensures that any voltage contacting the chassis would be diverted to ground.

Figure 11 shows the circuit board mounted in the box on short standoffs and the wiring to the power triac, potentiometer and AC cord and outlet.

Another difference between the circuit I built and the original schematic involved the timing components of the relaxation oscillator used to fire the triac. Even though the circuit worked well in the breadboard stage, I found

see **Basic**, *page 26*

Projects, *Cont'd. from page 21*

within the budget? (Never seems to in my case...)

Well, this stuff is just common sense, but it might help to ease some of the frustration when things go wrong, to have a plan of how you expect to get a project done. Remember Murphy's Law: Anything that can go wrong, will. But, hey, that's where the fun is, right? ❐

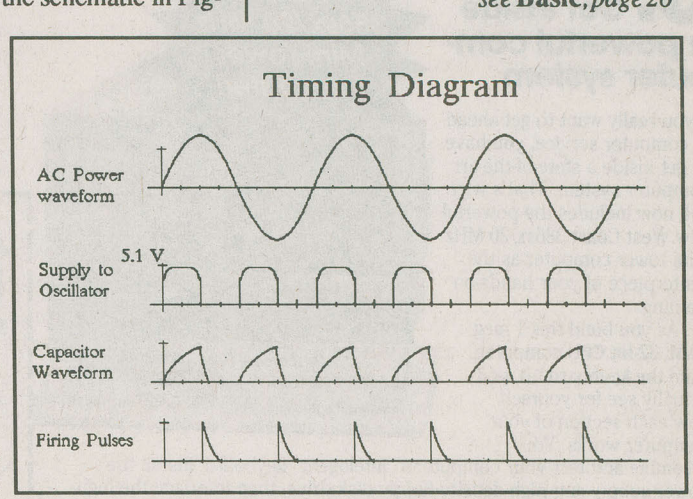

Figure 12. Phase Contol Waveforms

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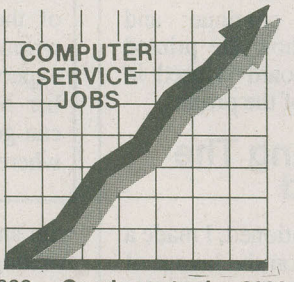

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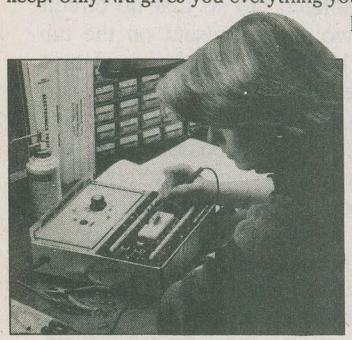

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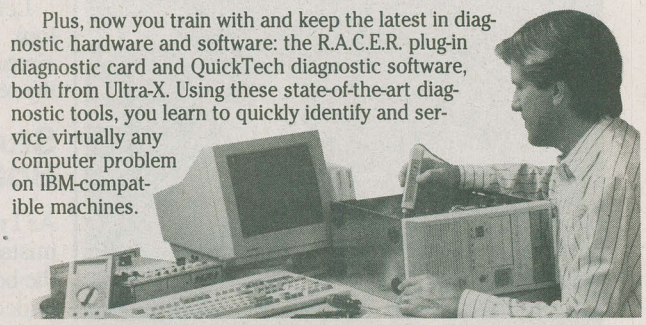

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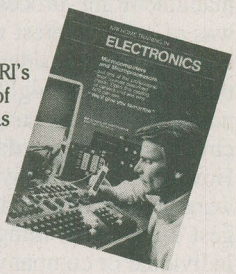

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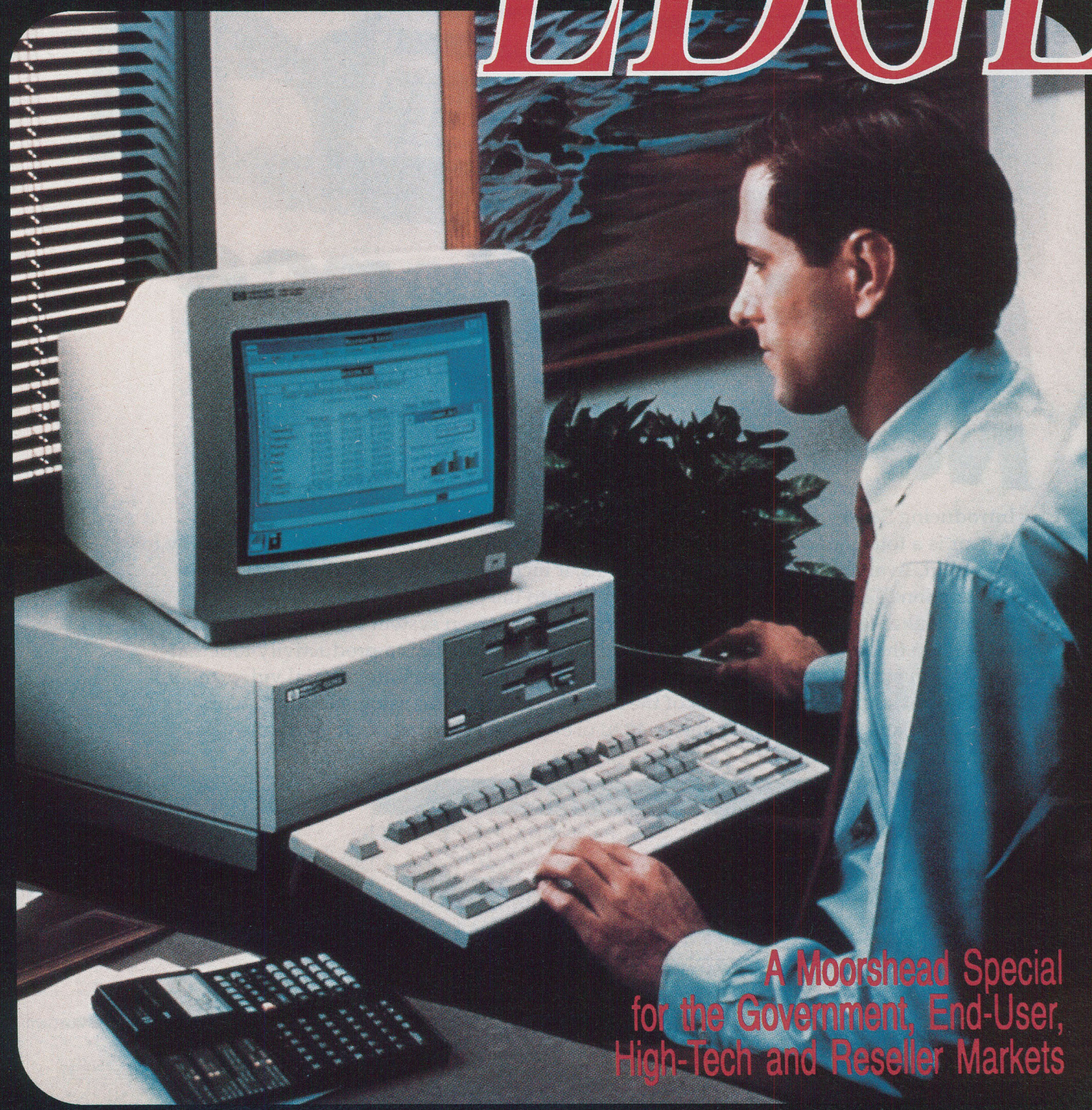

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Laser 486-25T Computer

This tower of power is designed for application critical situations and offers efficient use as a network sever or workstation unit.

The Laser 486-25T, from VTECH Laser Computers Ltd., is a serious powerhouse for applications which demand high micro-processing speed.

The unit is configured in the increasingly popular tower format, which enables the user to optimize desktop work space, as it can sit on the floor near or under the desk. The manufacturers have designed the case with rotating legs, and so secure positioning of the unit can be achieved very easily.

The unit utilizes Intel's 80486 micro-processor, which has built into it a math co-processor, a cache controller, and 8 K of cache RAM for frequently used data. The integration of the math co-processor into the CPU offers tremendous speed advantages over a 80386 with a 387 co-processor as data can be processed internally and does not have to be sent out through the bus.

Four I/O ports are provided (Parallel, 9 & 25 pin serial, and games port) and are built on to a single card along with the floppy drive controller and a IDE interface for a hard drive. Ten expansion slots allow for a wealth of peripherals and cards to be added, so expandability is not limited.

Memory can be expanded from the standard 2MB to 16MB through the use of Single In-line Memory Modules (SIMMS). There are

sixteen SIMM sockets on the motherboard. The general swing towards the use of SIMMs in the industry has been greatly appreciated, as it makes the task of upgrading memory almost as easy as plugging in a telephone.

VTECH will custom configure units to specifications, but the unit used for this review included both a 5.25" 1.2 MB and 3.5" 1.44 high density floppy drives, a 84MB 19ms access hard drive (any system purchased with a Laser hard drive includes the popular utility program PC Tools) as well a Laser Turbo VGA card and monitor.

The Laser 486-25T has been tested and approved by Novell Labs, a feature which continues to grow in importance to end users in the network server arena.

The system came with a "Quality Assurance" report, which details the configuration and the various stages the system had to pass through before reaching the point where it could be shipped out of the factory. The final stage is a functional test, where the machine is put through various diagnostics.

The Laser 486-25T provides high performance power in a tower format. Users working with a variety of mission critical applications will find the computer able to deliver the necessary speed and micro-processing power when the need arises. VTECH Laser's tower fills a tall order when it comes to almost any application.

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The Sensor SP-386SX

While some high end computers have crowded desktops, streamlined components and leading edge technology are combined in this computer for compact personal computing without sacrificing valuable desktop space.

The Sensor SP-386SX by Samsung delivers high quality computing in a compact design. From the packaging to the preconfigured hard drive with essential software, the Sensor SP-386SX offers users the latest in the field of user-friendly computing.

Packaged in one easy-to-manage box, the Sensor comes in components for easy setup and installation. Three smaller boxes contain the CPU, the Monitor and the Accessories. The system can be setup and running within minutes. Compliments go to the designers for the overall package. This is one of the easiest plug-and-play systems to come along in a long while.

The computer is compatible with the Intel 80386SX CPU running at 16 MHz with Phoenix BIOS. A co-processor can be added for enhanced operation. The Sensor is equipped with a Quantum 52 MB, 17 millisecond hard drive. Another disk drive is the IBM PS/2 compatible 3.5" floppy disk drive, able to read and write 1.44 Mb disks as well as 720 Kb disks. The computer comes with 2 Mb of RAM memory expandable to 8 Mb.

The Sensor comes with an installed 2400 baud Hayes compatible modem for instant communcations. Telephone jacks, located at the rear of the computer, are available for line and phone ports.

The slim front panel includes a hard drive indicator light, reset button, power button and 3.5" drive. Users have complete access to a variety of ports at the rear of the unit. Ports are available for 101-key IBM PS/2-style keyboard, IBM PS/2 compatible mouse, serial port, parallel port, video port, external floppy connector for Sensor External Floppy 5.25" diskette drive, and telephone jack for internal modem connection.

Upon power up, the Sensor goes through numerous system checks assuring the user of complete computer verification. Microsoft Windows 3.0, a proven user-friendly graphical user interface, offers a host of helpful applications. Balance Point is a personal financial management package. Your Way is a communications/notebook accessory. Norton Utilities 5.0, with mouse support, offers complete computer analysis for high quality performance. Norton Backup allows essential files to be saved and restored at user convenience. Prodigy is an on-line communications interactive personal service with start-up kit allowing users full access to a wide variety of services.

Another added feature of the Sensor is a complete tutorial. Using colour photographs, users are shown the exact interior components of the unit without having to open the case. Text and graphics combine to display some helpful hints and tips for care and use of the computer. Interactive function buttons guide the user through this well-designed tutorial.

To enhance the user-friendliness of the unit, the Accessory Box offers numerous helpful items. This box contains the mouse, Video Manual, telephone cable, Warranty Kit, Read Me First! for instructions on installation and set-up with complete illustrations, Quick Reference Guides for keyboard functions, Microsoft Windows 3.0 reference book, Guide of System Software for MS-DOS 4.01 and GW-Basic, complete User's Guide, and Applications Software manuals for the Norton Backup, Balance Point, Your Way and Norton Utilities 5.0.

The Sensor SP-386SX provides users with a combination of sleek design and powerful state-of-the-art components for high performance computing. Packaged with the user in mind, the Sensor offers quality software and user-friendliness for easy operation in any work environment.

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Ultinet
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Portable computing is the ideal when it comes to any working environment. With this notebook computer, users will be able to accomplish their computing tasks with ease.

The seven pound Ultinet 386SX Notebook Computer provides both the power and the portability to satisfy any user. This uniquely designed unit provides reliabilty plus ruggedness.

Operating with a 80386SX microprocessor at 8/16/20 MHz, with 80387SX copressor as optional, the Ultinet 386SX includes 1 Mb standard system memory while 2Mb to 8Mb are optional. EMS is also provided. The unit is fully compatible with MS OS/2, SCO Xenix, Novell, Lantastic and DOS software.

The 10" Supertwist LCD with CCFT backlit VGA display allows users to view the screen in different lighting areas. The screen offers 640 x 480 pixels with 32 gray scale levels and is the EGA, CGA, MGA and Hercules compatible.

For storage of valuable documents and applications, the Ultinet 386SX offers a built-in 20 Mb - 40 Mb hard disk drive, which can be easily upgraded to 60 Mb. Complementing this drive is a built-in 1.44 Mb floppy disk drive.

The enhanced multifunctional keyboard offers special function keys for extended operations such as visual display control, external display and traditional keyboard keypad.

I/O ports include two serial and one parallel port, an optional internal fax/modem, expansion box connector, and an external video port for a VGA multisync monitor.

Power is also a crucial factor when it comes to choosing a notebook computer. The Ultinet 386SX includes a lightweight AC/DC converter and battery charger combination. The changable and rechargable battery offers quick change function and is designed to last two to three hours per charge.

The notebook, which comes with a carrying case, has four power saving modes which extend battery life to between three to five hours on a single charge.

High performance computing is constantly demanded from many of today's power-hungry applications and operating environments such as OS/2 and UNIX. This 486 computer will meet these needs with power to spare.

The Ultinet 486 Computer is designed as a business or personal workstation and comes available in AT, tower or small footprint configurations. Eight compatible expansion slots are included. Six extended and two regular-bit slots support upgrades with a variety of AT-compatible and enhancement projects.

Accompanying the unit is a handy User's Manual. The booklet features information on an overview of the system, main board layout and description, BIOS setup, and main board circuit.

When it comes to speed, the Ultinet 486 computer wins the race. Using cache memory, the unit is able to deliver applications at incredible speeds.

Using an Intel 80486-33 CPU, running at 33 MHz, the Ultinet 486 is 100% IBM PC/AT compatible. Other unit features include Weitek 4167 co-processor socket support, total 64 Mb memory on board support and Page or 2/4 way Page-Interleave mode, and flexible architecture to support 64 Kb and 512 Kb burst mode cache subsystems.

For storage capabilities, there is support for up to 2 hard drives with capacities of up to 1.2 gigabytes per drive. There is also support for up to 2 floppy drives in either 5.25" or 3.5" sizes and all capacities.

Ports include one RS232C serial and one Centronics Parallel printer port. A 101-key keyboard is also included.

Powerful computing and fast operation are combined in this one unit. The Ultinet 486 computer provides the functionality and high quality performance to tackle many demanding applications and environments.

For more information contact:

Peter Halani
Ultinet Computer Corporation
3200 Dufferin Street
Unit 1B & 2B
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Greff 386-40/Cache Computer

Designed for powerful functionality, this computer can provide work efficiency for many applications.

Computer users rely on their hardware to get many jobs done both efficiently and accurately. The Greff 386-40/Cache Computer is designed specifically for meeting such needs.

The evaluation unit featured 128K Cache memory and 8 Mb main memory. It included a 130 Mb hard drive and both a 3.5" and a 5.25" floppy. Although this computer was configured as a desktop model, Greff also offers four different case styles – DeskTop, Slimline, Mini-Tower and Full Size Tower.

The Greff 386-40/Cache Computer operates with an 80386-40 microprocessor running at 40 MHz. As a desktop computer, users are offered a 5.25" 1.2 Mb and 3.5" 1.44 Mb diskette drives. Additional bays remain for two more 5.25" devices (i.e. tape backup, CD ROM unit, additional hard drive) and one hidden bay for a 3.5" hard drive. Users are offered increased functionality with a variety of hard drives ranging from 44 Mb to 2 Gigabyte. The review unit was equipped with a 130 Mb of hard drive with 64 K cache operating at 15 Ms. The computer includes 1 Mb of RAM standard and is expandable to 32 Mb of 32-bit RAM directly on the motherboard.

For external connection, the ports at the rear of the computer include one parallel port (25 pin), two serial ports (25 pin and 9 pin), and one game port (15 pin). Internally there are seven 16 bit slots and one 8 bit slot.

Operating with a Phoenix BIOS and built-in Setup routine, the Greff 386-40/Cache Computer offers a built-in clock and calendar. MS-DOS 5.0 comes standard for increased operations efficiency.

A 101-key keyboard is included in the package and features 12 function keys with separate cursor pad.

For enhanced operation, extended features include a built-in direct map cache controller. This employs write back cachability to improve cache hit rate. Cache RAM is expandable to 256 Kb from the original 128 Kb. Co-processor option includes 80387-40, Weitek 3167.

Many options are available to suit the needs of the user. The Greff 386-40/Cache Computer can be configured to meet any requirements.

The hard shell casing of the unit allows any high quality monitor to be placed on top without any fear of damaging internal components. The rugged metal cover provides a durable surface for any computer visual peripheral and its height from the desktop makes it ideal for high quality monitor viewing.

A complete Computer Operating Guide accompanies the unit and provides useful information for optimized computer productivity. This guide includes sections on Setting Up Your Greff Computer, Caring For Your Greff Computer, Keyboard Familiarization, What Is DOS?, Error Message Reference Guide, Hardware Troubleshooting, and Technical Support. Additional manuals are included detailing specific technical configuration information and hardware settings.

Users of the Greff 386-40/Cache will be pleased with this unit. Not only does it provide high quality computing power but it also allows expansion with durability.

For more information contact:

Greff Computer Corporation
80 Devon Road
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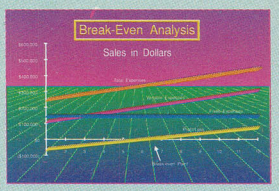

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IBM Personal System/1

Designed primarily for home use, this new computer offers easy to use features without the hassle of extensive setup or operation.

The IBM Personal System/1 computer (PS/1), distributed in Canada by Beamscope Electronic Entertainment, is one of the most user-friendly computers to appear on the market in recent months.

Available in a ready-to-use package, the PS/1 includes a display monitor, keyboard, modem, mouse and programs. Keeping the plug-and-play idea in mind when being developed, users can take the PS/1 out of the box, plug in a few cords, turn it on and begin. Using a point and click mouse, with an easy-to-use graphical user interface, users can begin computing almost immediately.

Users who work on presentations, letter writing, or spreadsheets will discover that the PS/1 helps to coordinate and store vital information necessary to complete that essential task.

When using the PS/1 users are able to take advantage of the simple instructions and Help directions whenever needed. The PS/1 is designed to be easy to setup, easy to learn, and easy to use. The computer has been developed to give users the ability to more effectively balance the time spent at the office and at home. With a variety of powerful options, the computer gives users the flexibility to run numerous business and other programs.

The PS/1 includes: an IBM Photo Graphic display for crisp, clear colour or black and white screen images; an IBM Selectric Touch keyboard for comfortable use; an 80286 processor running at 10 MHz to handle information at high speeds; a 30 Mb fixed disk drive; a 3.5" 1.44 Mb diskette drive to keep and carry large amounts of data; a built-in 2400 bps modem for high quality communications; and 512 Kb or 1 Mb standard memory.

The PS/1 also includes various pieces of software designed to increase productivity while providing easy-to-use functionality for the user. Standard software includes the IBM Disk Operating System (DOS R 4.01), Microsoft Works 2.0 (which includes word processing, spreadsheet, database and communications systems), the IBM PS/1 Computer System Tutorial and Microsoft Works Tutorial, and an Online Users' Club service.

With the PS/1 available to fit the various needs of users, many options are available depending on the unit selected. Optional features include 5.25" 360 Kb or 1.2 Mb diskette drive, adapter card unit with three card slots, audio card or audio card and joystick, and second joystick.

When you want easy to setup, easy to learn and easy to use computing, the PS/1 has been designed to meet your need. Various upgrade options are available to fit whatever your computing need. The IBM Personal System/1 can do the job for you.

For more information contact:

Beamscope Electronic Entertainment
35 Ironside Crescent
Scarborough, ON
M1X 1G5
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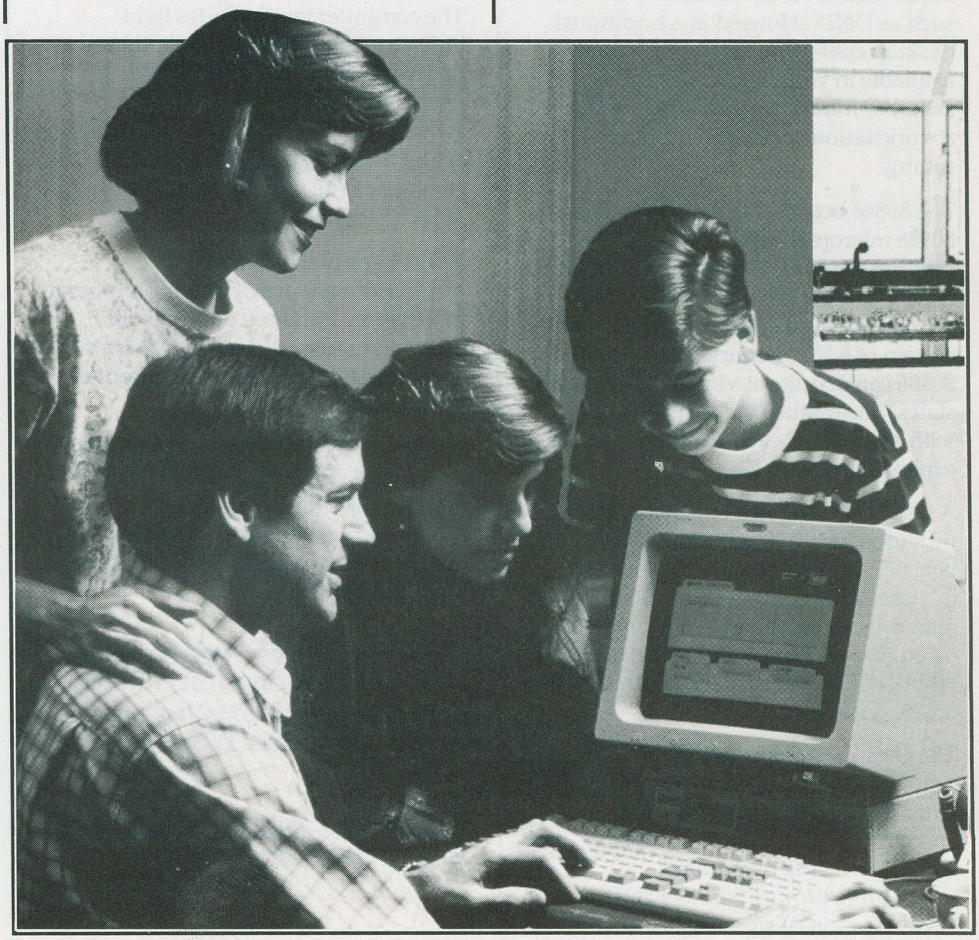

Orion 486 Computer

The processing power of the 80486 is available in this traditional desktop computer from Orion Electronics Supplies.

The Orion 486 Computer offers users the potential to exploit power hunger applications through the high quality performance of this unit.

With a 33 MHz 80486 board, the Orion 486 Computer has maximum on-board memory of 32 Mb. This meets the requirements for multi-user operations such as UNIX. Housed in a traditional desktop configuration (which is also available in various configurations such as full or mini tower), this unit will suit a workstation or complex application setting.

The 80846 board is based on the 32-bit 80486 microprocessor and the high performance OPTi chipset. This system is fully compatible with IBM PC/AT. With an internal system cache memory system of 8 Kb memory size, the CPU 80486 can operate at virtually zero wait states. The motherboard also comes with an external cache of 128 Kb that is expandable to 256 Kb.

A fast 32-bit memory expansion slot is provided for a memory daughter board. The installation is explained in the User's Manual. An extra 8 Mb of memory can be added to the system through use of the daughter board. In addition, 8 SIMM sockets are provided on the board.

The User's Manual, while appearing spartan in detail, does provide the user with the essentials to understand and operate the computer. This booklet includes a listing of features, Installation, Jumper Settings and Connector Pin Assignment, System Clock Speed Selection, and CMOS Setup Function. The Appendix sections are provided for the more advanced user. Addressing the memory and technical side of the unit, these sections feature information regarding the Daughter memory board, 32-bit memory assignment, system board layout, and a PC/AT system technical reference.

Both MS-DOS 5.0 and Windows 3.0 can be pre-installed on the hard drive at Orion. The forethought of installing this essential software gives the user one less thing to be concerned with when setting up the system.

The computer face includes light indicators for power, turbo and hard drive operation. In addition, a keyboard security lock, ON/OFF switch, a 3.5" drive, and a 5.25" drive are all included on the front of the computer. The unit also includes a 101-key keyboard.

At the back of the computer, connections are provided for peripheral installation. Ports are provided for monitor, mouse, and printer. Extra slots are available for additional computer enhancements.

The Orion 486 Computer provides the power and performance to run the most demanding of applications. Designed for expansion, the Orion 486 has the room to grow while delivering high quality results.

For more information contact:
Orion Electronics Supplies Inc.
40 Lancaster Street West
Kitchener, ON
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Leading Edge Computer Market Shows Growth

Recent studies reveal that the Canadian personal computer market has experienced a growth rate of 9.0% to 771,400 units. Its revenue grew at a rate of 10.5% to $2.033 billion. Several factors contributed to the relative stability of the personal computer industry in 1990. Downsizing, and the incumbent growth of networks of personal computers, continued to enhance the industry. Significant new product cycles, such as notebooks and workstations, gathered stream as product offerings increased. IBM and Apple addressed the homebound user aggressively with the PS/1 and the Classic. Windows 3.0 offered improvements in personal productivity with its increasingly functional graphical user interface.

A study of the market by segment reveals that the Scientific/Technical segment experienced the strongest growth in 1990. Unit shipments increased by 23.9% to 54,500 while revenue grew by 19.6% to $425.2 million. This market segment is showing impressive growth due to two factors. Users are developing a need for platforms running technical applications (such as CAD/CAM), while personal workstation products made vast improvements in price/performance ratios, spurred on by IBM's entrance into the market with the RS/6000.

The Business and Professional segment grew by 10.4% to 474,200 units in 1990. Revenue for this segment was $1.394 billion, an increase of 8.4% over 1989. Downsizing and the popularity of local area networks contributed to these results. In addition, new product cycles, such as notebooks and systems marketed for the homebound business user are creating a market for secondary equipment.

The Home and Hobby segment grew the slowest in 1990. Unit shipments increased by 1.1% to 160,800. Revenue in this segment grew by 8.2% to $105.1 million. Although more people are purchasing PCs for their home which offer some of the functionality of their desktop at the office, strictly home-oriented applications have not exited the marketplace yet.

Information supplied by IDC Canada.

The Hewlett-Packard Vectra 486/33T

Poised on the leading edge of PC technology, the Vectra 486/33T offers state of the art performance from a company with a pronounceable name.

Steve Rimmer

It's frequently said that no one even got fired for choosing IBM. It may not be verbalized as often, but the same usually holds true for Hewlett-Packard. While not quite as quickly thought of when one finds a desk that lacks a computer, Hewlett-Packard's *Vectra* systems have offered some pretty impressive performance for some years now.

Perhaps the most attractive aspect of the new Vectra 486/33T is the company behind it. While the system itself is truly impressive, it's probably just as worthwhile to note that it's built by a manufacturer who will unquestionably be around to service it long after many contemporary imported computer companies have dissolved into unanswered telephones and far Eastern post office box numbers.

Unlike a mid-range PC – which you might arguably buy just to have a computer to work with – the cost of the Vectra 486/33T presupposes that you'll probably have some serious work to do with it. Aside from being a well designed, well engineered system, the Vectra comes with a one year on-site warrantee. If it should do something untoward, someone from Hewlett-Packard will come and fix it so you can get back to work. You need not winch it into your trunk and drive it to the other end of town for a few weeks in the shop.

Floor Model

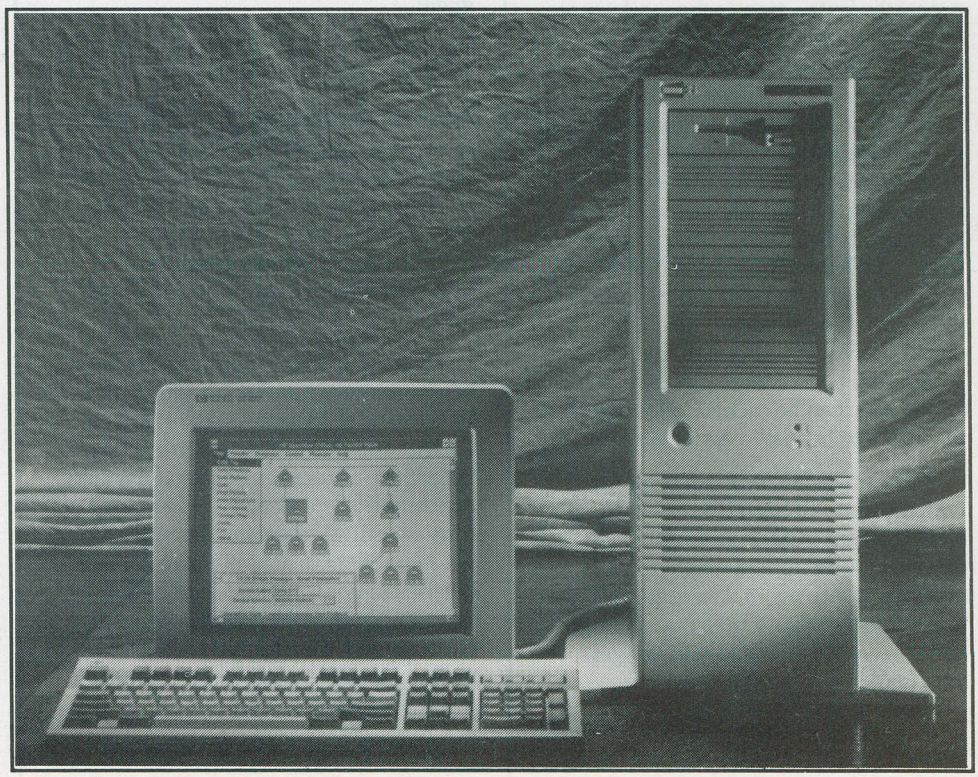
The "T" in Vectra 486/33T stands for tower. The system comes in a tower case which lives beside you desk rather than on it, a growing tend in 80486 based computers. This not only frees up a substantial bit of desktop real estate – it also allows the system monitor to reside at a much more comfortable level for most users.

The 80486 processor in the Vectra 486/33T runs at 33 megahertz – you might have deduced this from the name as well. Working at about fifty times the speed of a first generation IBM PC, it runs even really processor intensive software with amazing speed. Consider that it will recalculate in a minute a spreadsheet which would take almost an hour to recalculate on a stock PC.

For many users the Vectra 486/33T will look like the personal computer to end all personal computers. As long as you have a five figure Visa limit it makes a superb interactive system. However, it's worth noting that it can also serve as a powerful network server. With the appropriate hardware, it can serve up to a hundred terminals as a Unix platform.

The 80486 processor is actually a slightly faster version of the 80386 chip, with the addition of an integral math coprocessor. The latter makes the Vectra 486/33T a good choice for a CAD workstation, too – applications such as AutoCAD can't even imagine a world without a lot of floating point.

Unlike many 80486 based computers, the Vectra 486/33T includes a socket for a Weitek math co-processor. While



Vectra 486/33T *cont'd*

your accounting department may question why you need yet another math co-processor, having just bought a system which has one built in, the Weitek chip can outperform the 80486's internal floating point hardware. If you're running CAD software on the Vectra and you need a bit of extra performance, having recourse to a Weitek co-processor is a very powerful option.

The Vectra 486/33T has some impressive hardware inside its tower. This includes eight 32-bit EISA expansion slots. It comes with four megabytes of memory, expandable to 64 megabytes. I would imagine that even Microsoft Windows would be satisfied with 64 megabytes of memory, if only just.

It's worth noting that this is all zero wait-state memory.

One of the performance enhancements of the Vectra 486/33T which really makes a dent in the execution time of applications run on it is its 128 kilobyte external fast instruction cache. A processor instruction cache works more or less like a disk cache does. The memory in which program code resides is relatively slow. Cache memory is a lot faster. Because the nature of software frequently sees the processor executing the same code repeatedly, a cache allows the processor to reduce the time it takes to fetch instructions from memory by storing frequently used bits of code in the cache. A large cache, such as the one in the Vectra, means that a substantial part of your current application can be cached, allowing the processor to "cheat" very effectively.

The Vectra 486/33T can be equipped with a variety of hard drives based on a bus-mastered SCSI-2 controller. Hard drives holding up to a gigabyte are available. Once again, I'm quite certain that Windows could fill a one gigabyte hard drive, but it would take longer than usual to do so.

A growing number of new systems are appearing with SCSI hard drive controllers. While they don't offer a performance improvement over some of the older proprietary smart controllers *per se*, they do offer a lot of flexibility. Because it's based on a SCSI host adapter, you can add additional storage devices to the Vectra 486/33T without worrying about incompatible controller cards and without tying up additional slots. The basic SCSI host adapter which comes with the machine will control a DAT tape backup drive, a conventional streamer, a CD-ROM drive, an optical disk drive, a Syquest removable hard drive and several other specialized devices in addition to simply running your conventional hard drive. It can handle up to seven individual drives.

The SCSI-2 adapter in the Vectra supports the new fast SCSI standard, which means that it will be compatible with fast SCSI storage devices when they appear.

The hard drives which are available for the Vectra 486/33T are said to have a mean time between failure rate of 150,000 hours. This is a bit over seventeen years if you turn your computer on and never switch it off again.

Very Large
Programmable Calculator

It's hard to dislike the Vectra 486/33T. It's a very comfortable to computer to work with, and presents a feeling that it has been crafted, rather than merely assembled from off the shelf parts. Even the keyboard is agreeable – keyboards seem to have been a dying art form of late.

I ran a number of applications and benchmarks on the Vectra 486/33T. This included Windows, Excel, my ancient and exceedingly cranky copy of WordStar, numerous deliberately nasty benchmarks and Personal Composer, a music scoring program. The latter, while unlikely to actually turn up in a business environment, is one of the more exacting pieces of software I've encountered. Confronted with a less than compatible computer, it vents its displeasure by crashing.

Nothing crashed on the Vectra.

Windows was positively breathtaking, screaming along at speeds which would have been science fiction a year ago. None of my benchmarks complained, even the ones which ran in protected mode and don't get along well with reality in general.

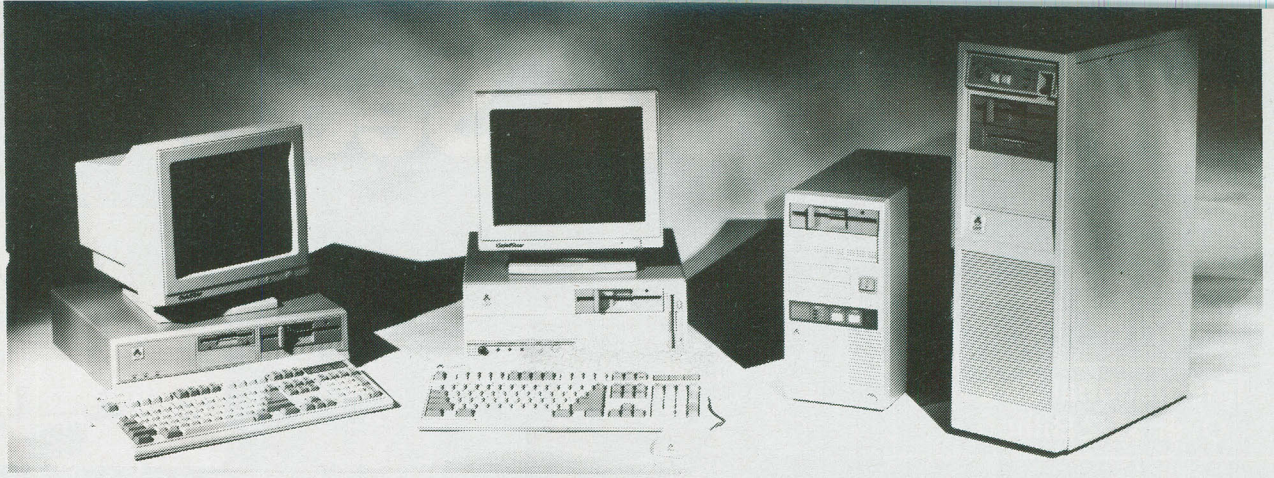
The only arguable drawback to the Vectra 486/33T is its price. Starting at over twelve grand without a hard drive, the Vectra systems are considerably more expensive than many other 80486 based systems. They cost about double what a low-rent 486 clone from Taiwan will set you back.

Having suffered through several generations of low-rent clones, I would consider the Vectra 486/33T pretty seriously if I were shopping for a system in this class. Unless you only want a machine to play computer games on, the object of buying a PC is usually to get some work done. While it may cost a lot more than some machines, the Vectra 486/33T strikes me as a computer which will continue to do what it's told to do for the foreseeable future. There are a lot of machines which can easily beat it out for price that don't inspire anything like the same level of confidence.

When your motherboard goes up in smoke as you're struggling to meet a deadline, having saved a few thousand dollars probably won't seem like it was a terribly good idea.

For more information contact:

Hewlett-Packard (Canada) Ltd.
6877 Goreway Drive
Mississauga, ON
L4V 1M8
Tel: (416) 678-9430



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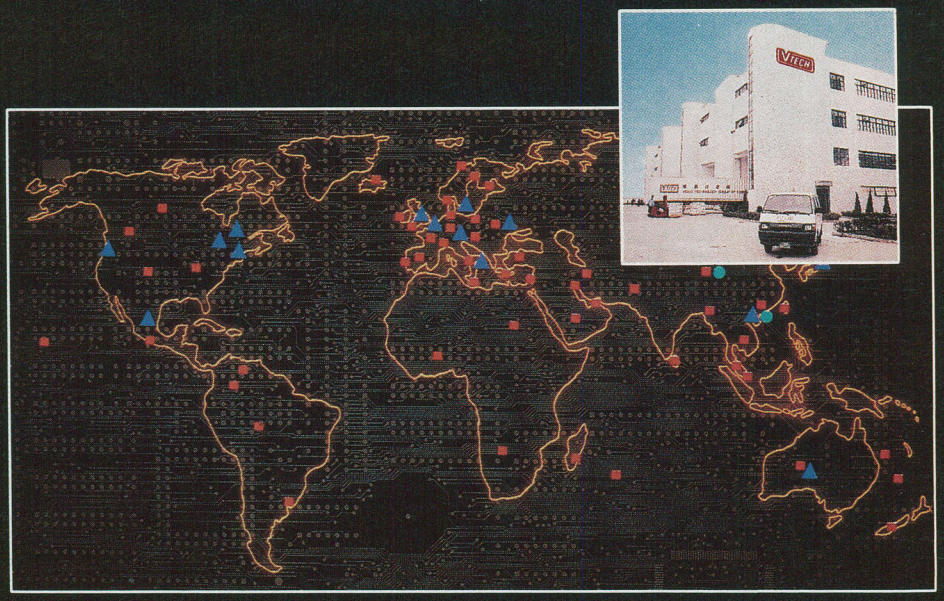

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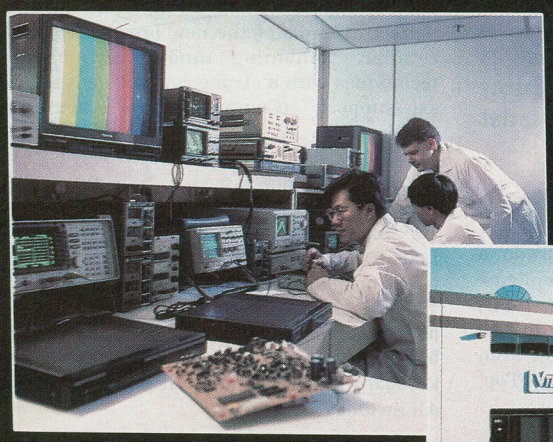

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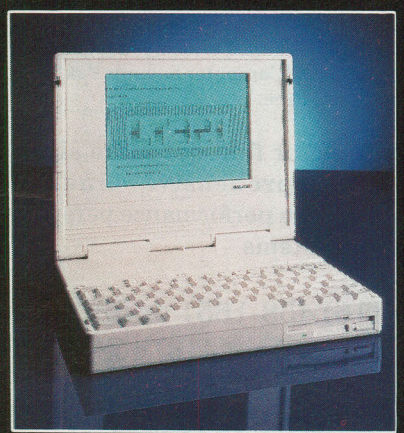

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FEATURE

Goodwill GOS-643 40MHz Oscilloscope

A precision, comprehensive dual-trace scope for general-purpose work from Duncan Instruments

by Bill Markwick

Duncan Instruments of Toronto is pleased to offer the Goodwill GOS-643 40MHz Oscilloscope. The Good Will Instrument Company of Taiwan has built up a solid reputation for precision test equipment at economical prices (you may find their trade name in North America is more often known as "GW"). The GOS-643 is no exception. It's a dual-channel, 40MHz (-3dB point) scope with a sensitivity of 1mV per division and a 6" (diagonal) rectangular CRT (8 by 10 divisions). The GOS-643 is the scope reviewed here. Ideal uses would be general testbench work, R&D, production, etc.

Unique features include a temperature compensation circuit to prevent DC shift and consequent straying of the beam, a 12kV acceleration circuit for bright images at high sweep speeds, and a linear focus that is maintained regardless of intensity changes. The manual introduction mentions "light-torque" switches laid out in a logical way for ease of use.

On the rear panel is a four-position voltage selector fuseholder and a removable line cord. Four plastic feet let the scope safely sit vertically, and slots in them serve as a storage winder for the line cord. Other rear panel features include a BNC for Z-axis (intensity) modulation, a BNC for Channel 1 output and a ground post.

First Impressions

On the rear panel, the storage space for the line cord is a blessing if you use it as a portable, as is the light weight (7.1kg). On the front, the controls live up their billing. All switches and buttons work smoothly with almost no effort or noise; the quality feel is that of a much more expensive unit. Layout is uncluttered and very easy to use.

The CRT traces, once aligned (just a tad of trace rotation needed), never drifted from a cold start to several hours of use (incidentally, the power consumption is listed at 50 watts maximum—the efficiency of the design meant that the scope never got more than slightly warm).

The claimed focus-stability feature seemed to work; there was little change over a wide intensity range, although overly-bright settings produced the usual blooming of the traces. The 12kV acceleration circuit did indeed produce clear images at the very highest sweep speeds, but some tweaking of the intensity was required.

A small point: the illuminated graticule needed better shading or alignment of the light bulbs. They're fitted at the bottom and produced uneven illumination of the screen if they were turned up brightly enough to light the graticule rulings.

see **Scope**, *page 33*

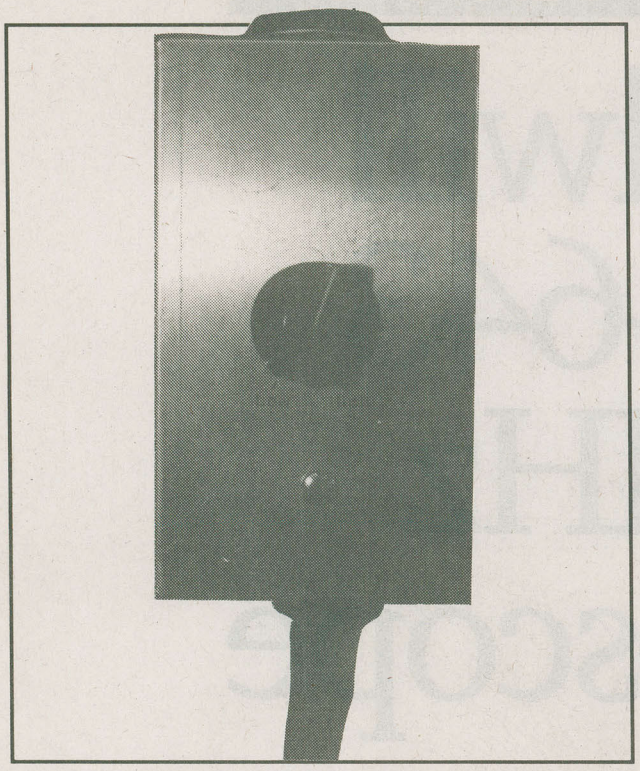


Figure 13. The Completed Variable Motor Speed Control

Basic, *cont'd. from page 23*

that the firing time was too long in the prototype. This caused the circuit to fire erratically at low speeds because the capacitor would charge up part way on each half cycle, finally reaching the firing point at unpredictable times, turning on the triac for a short burst of speed. The effect was that, as the potentiometer was turned counter-clockwise (increase of resistance), after a certain point the drill would periodically surge to a higher speed. I used my oscilloscope to check the timing of the capacitor charge/firing/discharge curve and found that it was too slow. After experimenting I found that a slightly smaller value of capacitance (0.047 µF instead of 0.1 µF) and a resistance of 24 k ohms in series with the 50 k ohm potentiometer gave a satisfactory control range from very slow to, almost, full speed output.

One final comment about the operation of the circuit: In last month's segment I included some timing diagrams which showed how the relaxation oscillator was used to fire the power triac through the opto-triac. These were correct as far as they went but if you end up troubleshooting this circuit with an oscilloscope you will see waveforms which look slightly different, especially with respect to the full-wave supply to the oscillator. Figure 12 shows the same timing diagram as before but includes the actual supply waveform, as seen across the 5.1 volt zener diode. You will note that whenever the UJT fires, the supply voltage drops to zero for the rest of that cycle. This is because, as soon as the UJT fires, which turns on the triac, there is no longer any voltage impressed across the UJT circuit. The power triac is connected directly across the UJT circuit and when it turns on it becomes a short — a closed switch — which has practically no voltage dropped across it. Until the cycle ends and the triac turns off, the voltage across the firing circuit is zero. After the end of the cycle the triac turns off and the whole thing starts over again.

The important point here is that, when testing with an oscilloscope, the supply voltage waveform (measured across the 5.1 volt zener diode) will look like a pulse which gets narrower as the speed of the drill is increased.

Conclusion

In spite of the 'chasing around' required to get set up to do photographic printed circuit boards, this is not a difficult project and the finished product worked with a minimum of after-construction troubleshooting required. If you try to build it you may find that an oscilloscope would be useful to determine exactly what is going on in the timing and firing circuits. In this article I purposely described the details — and options — of many of the steps so that those of you who are new to building projects might gain some perspective on the process. Hopefully this will help you to get started...

Next time... How about some op amps and comparators? See you then. ❐

Nikola Tesla

by George Colpitts

Things from the Dark Side and the Imagination of Nikola Tesla

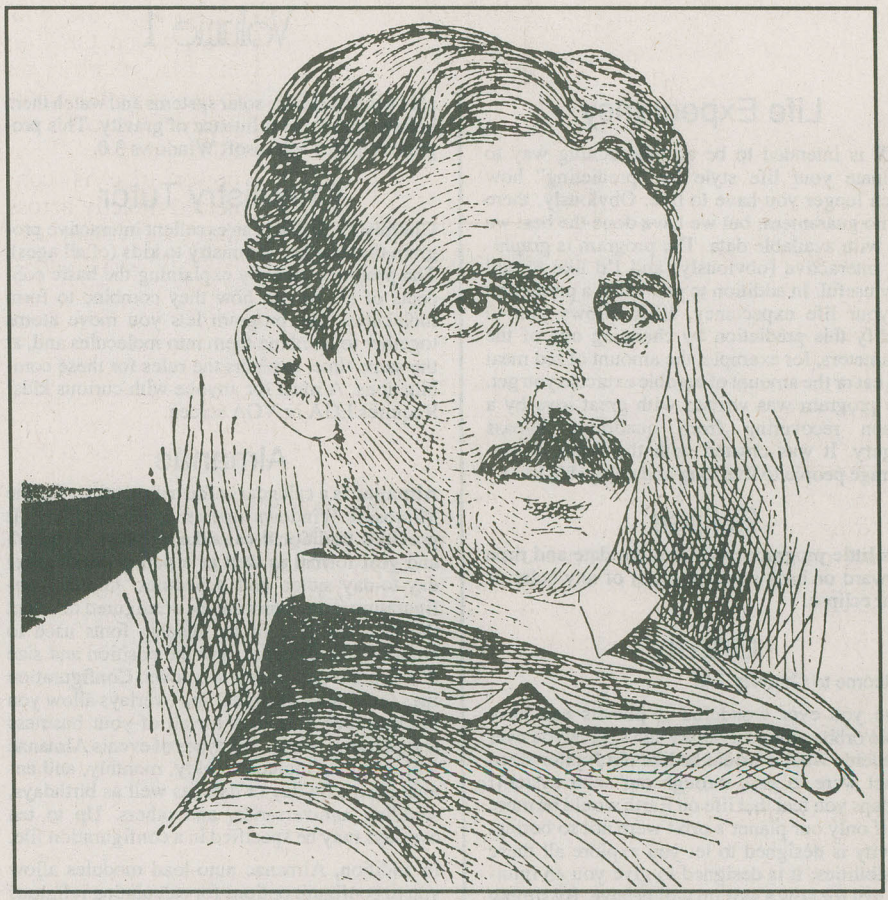
There was a dark side to electrical invention in the late 19th century. While converting electricity into everyday applications, the inventor himself became imbued by his medium, working in laboratory shadows, using fingers black with soot, and reeking of burnt ozone, acid — and brimstone.

Early in its development, electrical experimentation was closely associated with the occult. By the 1890s, both newspaper reporters looking for good copy, and scientists seeking names for themselves reported the industry's progress as if it was clandestinely tinkering with hell.

Moreover, the world of electricity was charged with occult terminology. Scientists were called "wizards" or compared with Greek gods, or pictured as grabbers of forbidden power. Their medium was equally mystical. Electromagnetic energy supposedly travelled in "ether", a mysterious fluid invisible and omnipresent. Electricity seemed to flow from an invisible world and carry inestimable power. It was the stuff of lightning bolts, and possibly divine retribution.

It was probably for this reason, rather than technological snarles, that direct current was consistently chosen over alternating currents almost to the end of the 19th century. Alternating currents were deadly (the fluid chosen for electric chairs), a lot more complex to work with, and more importantly, represented a complete abandon to a still mysterious and little-known force.

Although Westinghouse is often cited as Edison's rival who promoted AC, in many respects it was one of Edison's previous employees, Nikola Tesla, who eventually cut off direct current's application in everyday life and ushered in the era of high power AC electrical use.



An 1894 New York Times Drawing of Tesla

When Tesla arrived to the U.S. in 1884, he found North American industry completely entrenched in Edison's direct current systems. The engineer, however, was carrying in his luggage one of the great electrical breakthroughs: a prototype of his now-famous AC inductive motor which when powered, whirred silently with a rotating magnetic field.

It must be remembered that Edison's world was a relatively small one, a fea-

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Volume 1

Life Expectancy

LEX is intended to be an entertaining way to evaluate your life style by "predicting" how much longer you have to live. Obviously, there are no guarantees, but we have done the best we can with available data. The program is graphical, interactive (obviously) and I'd like to add very useful. In addition to providing a prediction of your life expectancy, LEX allows you to modify this prediction by changing one of the parameters, for example, the amount of red meat you eat or the amount of aerobic exercise you get. The program was written with great love by a person recovering from quadruple bypass surgery. It was created with the desire to encourage people to live long and enjoyable lives.

Eclipse

This little program calculates the date and time (forward or backwards in time) of any solar or lunar eclipse.

Gravity

Welcome to **Gravity 1.0!**

Have you ever wondered if planets can have stable orbits around a binary sun? Have you ever wondered what it would be like if a Jupiter-sized planet were to pass through our solar system? Perhaps you feel that life on Earth would be more fun if only our planet's orbit were not so boring. Gravity is designed to let you explore all these possibilities; it is designed to give you an intuitive feel for how a system will behave. By simply placing planets and dragging vectors you will be able to create entire solar systems and watch them behave under the influence of gravity. This program requires Microsoft Windows 3.0.

Chemistry Tutor

Chemistry Tutor is an excellent interactive program that teaches chemistry to kids (of all ages). The program starts by explaining the basic concepts of atoms and how they combine to form molecules. The program lets you move atoms together to combine them into molecules and, at the same time, explains the rules for these combinations. A must for anyone with curious kids! Requires EGA or VGA screen.

Almanac

Almanac is a calendar/information utility for the Microsoft Windows operating environment. It provides traditional calendar displays in month and year format as well as a popup desk set for day-to-day notes and schedules. Global configuration parameters can be configured to select the face and size of the display fonts used to compose the calendar, and the position and size of the main and popup windows. Configuration files (auto-load modules) and overlays allow you to customize calendars for all of your business and personal needs. The types of events Almanac will calculate include weekly, monthly, and annual events by day or date, as well as birthdays, wedding anniversaries, and others. Up to ten overlays may be specified in a configuration file.

In addition, Almanac auto-load modules allow you to configure options for calculating religious holidays (Christian and/or Jewish), phases of the moon, and calendar mode (Gregorian/Jewish). A location data base is used to select a geographic location for each auto-load module. This information is used to calculate the time and azimuth of sunrise and sunset for each day. All of the menu selections under 'Config' are stored in the auto-load module except the master directory path.

Psychiatric Medical Database

PsyMed is quick reference guide to the psychotropic medications. The software provides quick and easy access to over 130 medication definitions commonly needed by Mental Health professionals and others. With PsyMed you avoid the drudgery of searching through various medication books to find the medication you need information on. The information can be accessed instantaneously by various PsyMed "search" functions or by keying in a complete brand name spelling.

PsyMed provides condensed Indications, Adverse Reactions, Dosage, and Visual Identification information on all psychotropic medications contained in its' files.

Note: This program is really big, so it requires either a high density floppy drive or a hard disk to unarchive it.

$24.95 (Two Disk Set)

Volume 2

AMPTOOLS

Amptools is a wonderfully designed, easy to use program to automatically calculate the wire size, fuses, crossover capacitors and other functions when setting up a speaker system. Save hours of time and tedious calculations with this simple program. Just answer the prompts, type in the information and the answers are immediately presented to you.

Resistor Band Decoder

Do you have trouble remembering the standard resistor colour codes and have fits trying to apply the multiplier? Well here is a simple utility which makes extensive use of the IBM extended character set and the 16 colours available in EGA/VGA 80 column colour text mode (uses monochrome too) which makes it easy to get any resistor value.

The Resistor Band Decoder is a small useful utility which will give the value in ohms of a standard resistor given the colour of the bands which appear on the resistor. The program is simple enough to use, just start the program and it will prompt you for a two letter code for each band. The codes are available on the screen at all times. A representation of the resistor appears on the screen, and the colour bands will appear as you enter the codes for each band. Once you have entered all four colour bands, the resistor value and tolerance is displayed. A prompt to decode more resistors appears on the screen. The program terminates when you do not want to decode any more resistors.

Listening Room

Listening Room is software designed to minimize the effects of standing waves by determining desirable speaker and listener placement within the audio environment. Sitting in room locations where hot spots or nulls are absent provides a more natural, smoother response, removes the need for excessive equalization and reduces transient decay time.

The Listening Room runs on any IBM compatible machine with DOS 2.11 or better, 256K of RAM and Hercules compatible, CGA colour, EGA colour and VGA colour monitors.

Standing Waves

Due to the nature of home listening environments, low frequency standing wave patterns develop within the room which alter the apparent FREQUENCY RESPONSE and TRANSIENT DECAY TIME of the audio playback system. Standing waves exhibit themselves as pockets of low and high acoustic pressures and may be readily observed by walking around within the listening room while steady state, bass rich material is being reproduced. The response variations, which can exceed 25 db at different listening positions, cannot be properly compensated for by an electronic equalizer.

Of the various solutions to the standing wave problem, adjusting the loud-speaker and listening positions is the least expensive, most practical and often the most effective solution for the average homeowner or apartment dweller. If you are currently considering extreme measures to improve what your believe to be a problem room, use this program first. Many times, no further work will be required.

CW

CW was written to help prospective hams overcome what many perceive to be the biggest obstacle to obtaining an amateur radio license—learning the Morse code. There are numerous programs available in the public domain which send Morse code via a PC's speaker, but most are very limited and are written in BASIC, which requires a clumsy interpreter. CW seeks to provide a comprehensive program which provides several modes of learning and practising the code. The best features of other programs are included and many new features have been added to those previously available.

Hampac

Hampac is a wonderful program for anyone who is concerned for amateur radio, especially someone who is studying for their government test. It is an interactive program that asks questions and lets you answer. It also grades you on your answers. The program includes a novice theory test, a technical test, an advanced test, morse code practice, a simple calculator and a module to let you calculate four different types of antennas.

HOWTOFAX

Receiving Weather Satellite Imagery: A Beginner's Primer

Dedicated to satellite tracking, decoding of NOAA/Soviet meteorological satellite telemetry, and Digital Image Processing of satellite pictures.

How to Receive APT Pictures From the NOAA Satellites

So you have decided you want to receive the NOAA and Russian METEOR orbiters and you have a radio that receives 137.500 MHz and a computer. So now what do you do? This short dissertation will steer you in the correct direction.

Cordless

Ever wondered how to listen to cordless phone conversations. What frequencies are they on? Well here's the frequencies for the new cordless phones. You can set the channels up on most scanners so you can listen in on the neighbourhood gossip, etc.

You should be able to hear both sides of the conversation on either the base or handset frequencies due to the telephone hybrid circuitry.

Yagi

YAGI-UDA helps work out YAGI antenna calculations. Just run it... it explains itself.

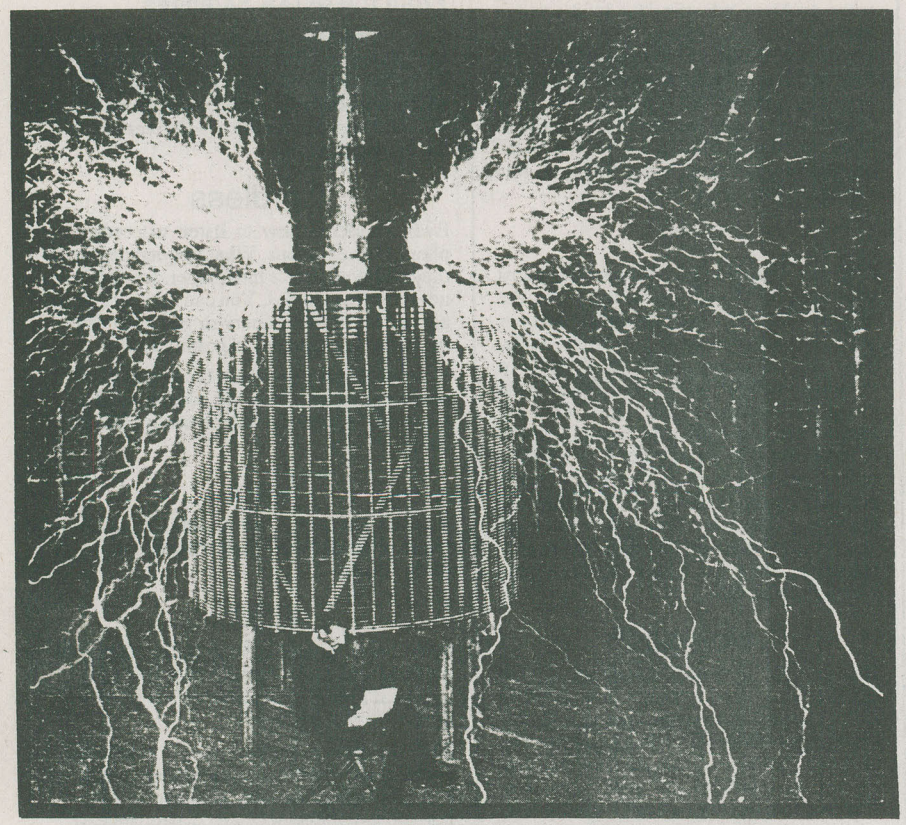
BDS

BDS is an engineering calculator that pops up from within any application. Just run it to load it into memory and hit Alt plus the tab key to make it appear.

BDS will calculate distance & azimuth, coordinates, depression angle, wavelength, FM blanketing contour, distance to radio horizon and inductance and capacitance. It will also function as a metric converter—a handy piece of software to have around.

$24.95 (Two Disk Set

This disk was created for Moorshead Publications by Chuck Ander, editor of *Electronics & Technology Today* magazine.



A Tesla Coil — What Else?!

ture that gave it an illusion of manageability to the user. Direct current was burnt up quickly into useless heat; every half mile, for instance, about 30 volts were lost before reaching customers. The Edison topography, then by necessity became reassuringly small to the user. Power stations were situated every five or six blocks and in many cases their turbines could be heard churning the power which illuminated a user's interior lights. The Edison world, although fraught with inefficiency, nevertheless still made some sense to users who easily charted the system in mental maps, and could remove themselves, at will, and relatively easily, from the electrical world.

To Tesla, who worked under Edison designing arc lights, the topography seemed ridiculous and he quickly introduced AC applications which startled the electrical community both by their power and innovation. By the end of his life, the Yugoslavian dreamed up the polyphase alternating current generator, and the basic principles of the radio, radar, electronic tube, X ray, fluorescent light, and electron microscope. Moreover, such developments as the Tesla Coil allowed for the transportation of AC over large distances, a feat out of the question for DC power stations.

In essence, Tesla threw away Edison's small mental terrain and replaced it with a complex world of long-distance, high power transmissions, connected with awesome electronics.

Throughout the late 19th Century until his death in World War II, Nikola Tesla, self-made eccentric and electrical prophet, whose mind seemed to possess dark, almost forbidden abilities, led society to leap in faith into the world of alternating currents, and plunge deep into the cult of electricity.

There can be no mistake that Tesla carefully constructed an eccentric image which intrigued colleagues, millionaire benefactors and the newspaper-reading public.

He arrived with four cents in his pocket from Yugoslavia, and he lived most of his life relatively penniless, even after a lifetime which produced some 900 patents. The *New York Times* reported Tesla's 1916 trial for tax evasion and the surprising disclosure that he lived mostly on credit, had "scores" of unpaid bills and when asked if he had any valuable assets such as jewellery, he replied: "No, Sir; I abhor jewellery."

Tesla, while not collecting personal wealth, lived most of his life holed up in lavish hotel rooms at the Waldorf or Ritz Carlton, amassing unpaid bills. He tramped around most of the day in "morning clothes," fed the pigeons at the nearby St. Patrick's Cathedral and taped the doors of his room to stop germs from seeping underneath.

His birthdays were appropriately celebrated in public light: New York city reporters invited to his hotel room were given belts of scotch and descriptions of his last year's work, usually just as jolting as the booze. He had announced on his 78th birthday, for instance, his discovery of a death ray which could kill millions of people in a single pass. By the end of his life, his theories became progressively more ambitious to the point that they made good news copy, but little else. And it was no surprise that after his death during World War II, the FBI confiscated his files for fear they contained material the Nazis could use to take over the world.

Tesla seemed to have been both scientist and carnival conjurer. During the 1890s Hollywood actors, political dignitaries and famous writers visited his lab in lower Manhattan — usually in the dark of night — where they witnessed scientific "demonstrations" which have never been fully explained. One of Tesla's favourite tricks was to hold a ball of glowing electricity in his hand; another, to throw bolts of lightning across the room or cast light on particular objects from apparently no source. All of the experiments smack now as a bit of slight-of-hand mesmerism, or tapped from the cane of a Las Vegas magician. At the time, though, such demonstrations ran his reputation wild. A 1894 *Times* article described one reporter's experience:

"In some lamps Mr. Tesla had placed substances that phosphoresced, under the stimulation of the currents reaching them across many feet of space..."

As his friend and biographer, John O'Neill, science editor of the *New York Herald Tribune* said, the tricks "suggested this magician's chamber was

connected directly with the seething vaults of hell."

But while Tesla seemed to flow his life into an eccentric mold, there was no explaining away the awesome Tesla mind, attributed directly to the electrical revolution in the first decades of the century.

Mathematically adept and able to memorize effortlessly, Tesla was able to quickly seize electrical theory and channel his full energy into design. As a student at engineering college in Yugoslavia, he often lay on his bed assembling inventions mentally.

Before he began full-time inventing, Tesla admitted in autobiography that he spilled his mental abilities into occult-like uses, the most unsettling being what he refers to as thought travel: "...so I began to travel — of course, in my mind," he writes. "Every night (and sometimes during the day), when alone, I would start on my journeys — see new places, cities and countries — live there, meet people and make friendships and acquaintances."

Later, he said, his mind's capacity for such visualization helped him design electrical systems. Without blueprints or diagrams, Tesla built the first alternating current motor with a rotating magnetic field, *in his mind.* Moreover, he said that he had tested the motor, running it for a few weeks to see if there was any faults, *in his mind.*

In a series of autobiographical features in *Electrical Experimenter* in 1919 he wrote: "I started by first picturing in my mind a direct-current machine, running it and following the changing flow of the currents in the armature. Then I would imagine an alternator and investigate the processes taking place in a similar manner. Next I would visualize systems comprising motors and generators and operate them in various ways. The images I saw were to me perfectly real and tangible."

The design of the induction motor kicked the stool out from under the electrical community. But its design, although brilliantly innovative, reflected also the Tesla mindset, and cast shadows of the work which would extend throughout his life. Tesla had struck out at theory before practice, something Edison hadn't really done. Edison was busy hammering square pegs into round holes a lot of the time, a methodology which irritated Tesla considerably.

Recent Tesla Experiments in Berlin.

An 1895* New York Times *illustration of Tesla demonstrating coil and light innovations.

Moreover, the induction motor did away with the cumbersome brushes and commutators which made up DC motors. Tesla *hated* clumsy physical contact between energy sources and their applications. The quiet running, low-maintenance induction motor had an armature driven, it seemed to contemporary observers, magically. Tesla devoted his life to other grandiose applications of wireless, and hence, magical, power transmission, which eventually stirred The *New York Times* editor to complained that Tesla produced "revolutionary inventions that never quite arrived at the point of practical utility."

One such useless experiment was performed in 1912, when Tesla announced he was collaborating with a school teacher in the U.S. to make "mentally deficient" students smarter. The experiment involved installing Tesla coils in the walls so that "invisible electrical currents will run, by means of which ... the brains of the children will receive artificial stimulation." Tesla said he was prompted to perform the experiment after he observed that one of his assistants, who was "exceedingly stupid", had appeared much smarter after working around Tesla's snapping, high-voltage coils.

But whether Tesla was working on educational stimulants, or communicating to Mars (he and Marconi had a running argument over the subject, Marconi wanting to transmit mathematical codes; Tesla wanting to transmit pictures) or patenting in 1915 a new park water fountain which used less water, Tesla maintained the public's confidence. He received funding from millionaires such as J.P. Morgan, John Jacob Astor, and John Hays Hammond who ardently believed he would, someday, culminate his work with a new world order, maintained by electricity.

One of Tesla's legacies was a long list of innovations, often never fully developed in his lifetime, but which are now becoming valuable to the scientific community. In 1887, for instance, he filed patents to use the loss of magnetism in iron when it is heated to temperatures above 750 degrees centigrade, a process being reinvestigated for energy conservation. In 1891, he patented a medium frequency generator which much later had broad application in broadcasting stations. That year he also tackled problems of electrical insulation and created an electrical condenser, composed of plates and im-

Not Built To Be But A Landmark

Like the rest of Tesla's mystery, the purpose of this mushroom tower with its 185 feet of structure and its copper-covered dome, is unknown. But Tesla still dreams, and it may yet come to life.
(from* Literary Digest *Article, 1916)

mersed in insulating oil, a design used to the present.

The most conservative histories of Tesla cite the Tesla Coil as being his great contribution to long-distance power transmission and what eventually allowed for the tapping of Niagara Falls power. But Tesla envisioned a more ambitious use for his coils, the most interesting being a way to create world-wide wireless power transmission.

After building larger and larger coils within his lab and finally deciding he would have to move out-of-doors after 4,000,000 volt potentials were arcing into the room's walls, floors and ceilings, Tesla commenced work on the famed tower built in Colorado Springs. There, in the mountainous geography, the tower was Babel-like in ambition and a monument to Tesla's determination. The tower bristling with coils and receptors was 80 feet above the ground and created, according to Tesla, something around 135,000,000 volt potentials. He claimed that he lit 200 incandescent bulbs 26 miles away with "wireless" power.

Tesla also built a tower on Long Island, abandoned soon after construction but of similar dimension, crowned with an ominous copper dome. Town residents living nearby believed the scientist was going to connect the tower to an elaborate system of super conductors around the globe, or simply communicate to Mars. It made good press, but Tesla never actually used the machinery.

Behind the project remained Tesla's goal to eventually charge the earth with tremendous voltages and make it "oscillate," making it possible, anywhere on the globe, to tap into power wirelessly. And even though he met with failure all his life in this plan, he never stopped planning for the day when he would create wireless unmanned drones which would patrol the continent's coastlines, and would target and destroy enemy ships and airplanes before they left their bases. "Wars of the future will not be waged with explosives but with electrical means," he said after describing his theories.

Mostly, however, Tesla planned for peace. He saw the grand electrical schemes allowing for wireless telephony around the world, illuminating the sky at night when needed, watering deserts and correcting bad weather systems. To people who scoffed at such ambitions, he repeated that he didn't care if the world thought he was insane.

In a *Newsweek* article written just before his death in January 1943, Tesla was described as spending most of his hours alone in his room at the Hotel New Yorker, most likely the hotel's most eccentric guest at that time. Still a bachelor, and having devoted his entire life to electrical theory, he looked more like a comic than a genius. He wore long underwear, golf stockings and high-laced boots. When maids came in he slipped on a bathrobe. Most often they found him sitting on the edge of his bed, contemplating his pet pigeons which pecked at seed in their cage. Or they found him "moodily" thinking.

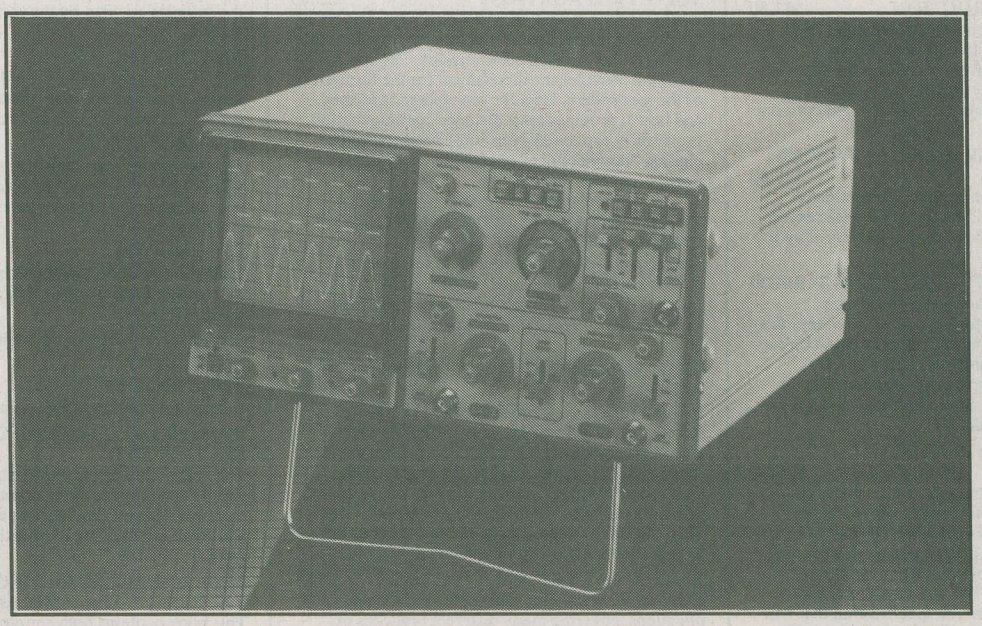
His alchemy, whether applied to practical electronics, or to futurist fantasies, it seems, never came to an end. ❐

Scope, *cont'd. from page 25*

Included are two leads with spring-loaded end hooks and a switch for x1 or x10 settings (which I've always thought should be labelled as divide-by-10). A 2Vp-p positive-going calibrator at about 1Khz can be used to adjust the lead compensation setting for flat frequency response, and it's also handy for confirming your control settings during those panicky moments ("Where am I? Is this DC or what? What's my signal doing there?")

Vertical Amps

No surprises here. The attenuator switches have settings from 5mV/div to 5V/div, with a times-5 magnifier giving a maximum sensitivity of 1mV/div. Accuracy of the attenuator is listed at +/-3% for the normal range and +/-5% for the magnified range. Maximum input at the BNC is 400Vp-p, with the test lead attenuator letting you extend this (just how much depends on safety—you obviously shouldn't put 4kV into standard test leads). Input impedance of both channel inputs is fixed at one megohm +/-2%, with 30pF capacitance.



The AC/DC switches also have a Ground position, nice for positioning the traces or momentarily shutting off an input.

The Mode switch can be set to Channel 1 only, Channel 2 only, Dual, and Add for differential inputs (with an Invert switch also available on Channel 2). Variable-gain pots on the sensitivity control let you fine-tune the differential balance. The traces can be set to Alt or Chop, with the chopping frequency at 250kHz.

Channel 1's output can be switched into the X amplifier, replacing the internal timebase if you need X-Y inputs. The bandwidth of the X axis becomes DC to 1MHz.

Horizontal Amp

The timebase controls for the GOS-643 are comprehensive. The triggering source can be just about anything you want: Channel 1, Channel 2, AC/DC, HF filtered, TV fields (with sync separator), power line, or External (BNC connector). A slope control lets you trigger on positive or negative waveforms. The triggering level control lets you do fine adjustments for difficult waveforms, though the automatic setting seemed just fine for most cases.

The triggering Hold Off control is used to delay the trigger point until it gets to the part of the waveform that gives you the most desirable display. If you have a complex wave made up of multiple frequencies, it's possible that the trigger will lock to a part that causes overlapping of waveforms on the screen. The Hold Off can shift the triggering to prevent this.

One-shot triggering can be selected for aperiodic or transient signals. Pushing the one-shot button displays one trace of the signal, particularly good for screen photography. It can also be set to automatically trigger itself one time when the transient appears.

The slowest sweep time is 0.5s/div, and the fastest is 0.2us/div, with the sweep x10 magnifier giving a maximum speed of 20ns/div.

The delayed sweep on the GOS-643 can be set from 2us/div to 5ms/div, letting you greatly expand fast waveforms. Triggering delay can be added to minimize jitter. Since it's possible to set two timebases, A and B (GOS-643 only), you can expand the signal up to several thousand times, depending on the ratio between the A and B settings.

Despite the apparent complexity of the timebase controls, they're well designed and easy to learn.

Other Specifications

If you need to use an external triggering signal, the sensitivity of the front panel BNC is 0.1V/div with a maximum input frequency of 2MHz. The Z-axis input has a maximum sensitivity of 3Vp-p and a maximum input rate of 5MHz, with positive signals causing blanking.

The rear panel Channel 1 output is a 50-ohm BNC with an output level of approximately 100mV per division of graticule, good for frequency counters, etc.

The 28-page manual is sparse but clearly written. It would benefit from an index or at least a good table of contents, since much page flipping is required to find a particular function. The technical reference is limited to spec charts and a block diagram.

In general, the GOS-643 is well made, with a front panel layout that's very easy to learn and use. The comprehensive horizontal amplifier makes it a good investment for general use in applications from DC to 40MHz. For more information contact: Duncan Instruments, 121 Milvan Drive, Weston Ontario M9L 1Z8 Tel: (416) 742-4448 Fax: (416) 749-5053 ❐

Babani Books

New Releases

BP265: MORE ADVANCED USES OF THE MULTIMETER $11.80
This book is primarily intended as a follow-up to BP239, and also should be of value to anyone who already understands the basics of voltage testing and simple component testing.

BP266: ELECTRONIC MODULES AND SYSTEMS FOR BEGINNERS $15.80
This book describes over 60 modular electronic circuits — how they work, how to build them, and how to use them. The modules may be wired together to make hundreds of different electronic systems, both analogue and digital. To show the reader how to begin building systems from modules, a selection of over 25 electronic systems are described in detail, covering such widely differing applications as timing, home security, measurement, audio, games and remote control.

BP276: SHORT WAVE SUPERHET RECEIVER CONSTRUCTION $11.80
The basic short wave receiver described in this book is a superhet type having separate mixer and oscillator stages, two i.f. stages, a ceramic filter to provide good selectivity and a simple audio amplifier which will drive headphones. An optional b.f.o. permits reception of c.w. and s.s.b.

BP277: HIGH POWER AUDIO AMPLIFIER CONSTRUCTION $15.80
This book provides background information on high power audio amplifiers, together with some practical designs capable of output powers of up to 300 to 400 watts r.m.s.

BP278: EXPERIMENTAL ANTENNA TOPICS $15.80
Although nearly a century has passed since Marconi's first demonstrations of radio communication, there is still research and experiment to be carried out in the field of antenna design and behaviour. This is a practical book with text closely supported by diagrams. Some formulae and simple graphs are also included.

BP282: UNDERSTANDING PC SPECIFICATIONS $15.80
If you require a microcomputer for business applications, or a high quality home computer, an IBM PC or compatible is often the obvious choice. They are competitively priced, and are backed up by an enormous range of applications programs, hardware add-ons, etc. The main difficulty for the uninitiated is deciding on the specification that will best suit a person's needs. This book explains PC specifications in detail, and the subjects covered include: types of PCs, math co-processors, memory, display adaptors and more.

BP285: A BEGINNERS GUIDE TO MODERN ELECTRONIC COMPONENTS $15.80
It is easy for beginners and advanced users alike to become confused by the wide range of components currently available. In this book, the basic functions of the components are described. The main thrust of the book is concerned with practical aspects such as colour codes, deciphering code numbers and the suitability of components for given applications. Essential reading for all electronic enthusiasts, this book presents a vast amount of invaluable information to enable you to select the right components every time.

BP290: AN INTRODUCTION TO AMATEUR COMMUNICATION SATELLITES $15.80
Communications and broadcast satellites are normally inaccessible to individuals. There are a large number of amateur communications satellites in orbit around the world, and they can be tracked and their signals received with relatively inexpensive equipment. This equipment can be connected to a home computer such as the IBM compatible, for the decoding of received signals. This book describes several currently available systems, their connection to an appropriate computer and how they can be operated with suitable software.

BP292: PUBLIC ADDRESS LOUDSPEAKER SYSTEMS $15.80
The loudspeaker system is a critical part of any public address installation. All too often it is woefully inadequate, resulting in poor intelligibility and unnatural reproduction. We here examine the various systems and their drawbacks, and describe LISCA, the Line-Source Ceiling Array. This gives astonishing clarity, even coverage, reducing feedback, natural source location and even a pseudo-stereo effect. It promises to be the ultimate system for small to medium sized halls. Full step-by-step construction and installation details are given.

BP293: AN INTRODUCTION TO RADIO WAVE PROPAGATION $15.80
Radio wave propagation, one of the more important discoveries made in the early 20th century, has its origins in the world of solar physics. The sun's radiation provides the mechanism for the formation of the ionosphere. How the ionosphere is formed, and how it provides long-distance communication, is carefully explained. Non-ionic propagation, including "moonbounce" or satellite communications, is covered as well.

BP7: RADIO AND ELECTRONICS COLOUR CODE AND DATA CHART $3.00
Opens out to Wall Chart and includes many Radio & Electronics Colour Codes in use in UK, USA, Europe and Japan. Covers Resistors, Capacitors, Transformers, Field Coils, Fuses, Battery Leads, etc.

BP37: 50 PROJECTS USING RELAYS, SCR's & TRIACS $7.80
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Relays, bi-directional triodes (TRIACs), and silicon controlled rectifiers (SCRSs), have a wide range of applications in electronics today. This book gives practical working circuits which should present a minimum of difficulty for the enthusiast.. Most circuits include a wide latitude in component values allowing easy modification and adaptation.

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Contains 50 interesting and useful circuits and applications, covering many different branches of electronics, using one of the most inexpensive and available components.

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Every so often a device appears that is so useful that one wonders how life went on before it. The 555 timer is such a device included in this book are Basic and General Circuits, Motor Car and Model Railway Circuits, Alarms and Noise Makers as well as a section on the 556, 558 and 559 timers.

BP48: ELECTRONIC PROJECTS FOR BEGINNERS $7.80
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In this book, the newcomer to electronics will find a wide range of easily made projects. Also, there are a considerable number of actual components and wiring layouts, to aid the beginner.

BP49: POPULAR ELECTRONIC PROJECTS $10.00
by R. A. Penfold
Includes a collection of the most popular types of circuits and projects which will provide a number of designs to interest most constructors. The projects are divided into four basic types. Radio Projects, Audio Projects, Household Projects and Test Equipment.

BP51: ELECTRONIC MUSIC AND CREATIVE TAPE RECORDING $5.85
This book sets out to show how Electronic Music can be made at home with the simplest and most inexpensive equipment.

BP53: PRACTICAL ELECTRONIC CALCULATIONS AND FORMULAE $11.75
A book that bridges the gap between complicated technical theory and the cut and try method.

BP59: SECOND BOOK OF CMOS IC PROJECTS $7.80
This book carries on from its predecessor and provides a further selection of useful circuits, mainly of a simple nature. The book is well within the capabilities of the beginner and more advanced constructor.

BP— ELEMENTS OF ELECTRONICS — AN ON-GOING SERIES $11.80 EACH OR ALL 5 BOOKS FOR $44.00
F.A. Wilson, C.G.I.A., C.Eng.,
Although written for readers with no more than ordinary arithmetical skills, the use of mathematics is not avoided, and all the math required is taught as the reader progresses. Each book is a complete treatise of a particular branch of the subject and therefore, can be used on its own with one proviso, that the later books do not duplicate material from their predecessors, thus a working knowledge of the subjects covered by the earlier books is assumed.

BP62: BOOK 1.
This book contains all the fundamental theory necessary to lead to a full understanding of the simple electronic circuit and its main components.

BP63: BOOK 2.
This book continues with alternating current theory without which there can be no comprehension of speech, music, radio, television or even the electricity utilities.

BP64: BOOK 3.
Follows on semiconductor technology, leading up to transistors and integrated circuits.

BP77: BOOK 4.
A complete description of the internal workings of microprocessor.

BP89: BOOK 5.
A book covering the whole communication scene.

BP78: PRACTICAL COMPUTER EXPERIMENTS $5.25
The aim of this book is to enable the reader to simply and inexpensively construct and examine a number of basic computer circuit elements and gain a fuller understanding of how the computer chip works.

BP84: DIGITAL IC PROJECTS $7.80
F.G. Rayer, T. Eng. (CEI), Assoc.IERE.
This book contains both simple and more advanced projects for the reader developing a knowledge of the workings of digital circuits. To help the newcomer to the hobby the author has included a number of board layouts and wiring diagrams.

BP72: A MICROPROCESSOR PRIMER $5.25
In an attempt to give painless approach to computing, this inexpensive book will start by designing a simple computer and then the short-comings of this simple machine will be discussed and the reader is shown how these can be overcome.

BP74: ELECTRONIC MUSIC PROJECTS $10.00
R.A. Penfold
Although one of the more recent branches of amateur electronics, electronic music has now become extremely popular. The purpose of this book is to provide the constructor with a number of practical circuits for the less complex items of electronic music equipment, including such things as a Fuzz Box, Waa-Waa Pedal, Sustain Unit, Reverberation and Phaser Units, Tremolo Generator, etc.

BP85: INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE $9.00
Designed to help the user find possible substitutes for a popular user-oriented selection of modern transistors and includes devices produced by over 100 manufacturers.

BP92: ELECTRONICS SIMPLIFIED - CRYSTAL SET CONSTRUCTION $5.25
This is a book written especially for those who wish to participate in the intricacies of electronics.

BP94: ELECTRONIC PROJECTS FOR CARS AND BOATS $7.80
R.A. Penfold
Projects, fifteen in all, which use a 12V supply are the basis of this book. Included are projects on Windscreen Wiper Control, Courtesy Light Delay, Battery Monitor, Cassette Power Supply, Lights Timer, Vehicle Immobiliser, Gas and Smoke Alarms.

BP95: MODEL RAILWAY PROJECTS $7.80
Electronic projects for model railways are fairly recent and have made possible an amazing degree of realism. The projects covered included controllers, signals and sound effects: stripboard layouts are provided for each project.

BP98: POPULAR ELECTRONIC CIRCUITS, BOOK 2 $9.00
R.A. Penfold
70 plus circuits based on modern components.

BP101: HOW TO IDENTIFY UNMARKED IC's $1.95
An unusual and fascinating chart that is highly recommended to all those interested in electronics and which will hopefully pay for itself many times over, by enabling the reader to use IC's that might otherwise have been scrapped.

BP103: MULTI-CIRCUIT BOARD PROJECTS by R.A. Penfold $7.80
This book allows the reader to build 21 fairly simple electronic projects, all of which may be constructed on the same printed circuit board. Wherever possible, the same components have been used in each design so that with a relatively small number of components and hence low cost, it is possible to make any one of the projects or by re-using the components and P.C.B. all of the projects.

BP106: MODERN OP-AMP PROJECTS by R. A. Penfold $7.80
Features a wide range of constructional projects which make use of op-amps including low-noise, low distortion, ultra- high input impedance, high slew-rate and high output current types.

BP110: HOW TO GET YOUR ELECTRONIC PROJECTS WORKING $7.80
R.A. Penfold
We have all built circuits from magazines and books only to find that they did not work correctly, or at all, when first switched on. This book will help the reader overcome these problems by indicating how and where to start looking for many of the common faults that can occur when building up projects.

BP111: AUDIO $14.00
Covers a wide range of material from analysis of the sound wave, mechanism of hearing, acoustics, microphones and loudspeakers, amplifiers, and magnetic disc recording.

BP115: THE PRE-COMPUTER BOOK $5.85
Aimed at the absolute beginner with no knowledge of computing, this entirely non-technical discussion of computer bits and pieces and programming is written mainly for those who do not possess a microcomputer but intend to one day own one.

BP118: PRACTICAL ELECTRONIC BUILDING BLOCKS – BOOK 2 $7.60
R.A. Penfold
This sequel to BP117 is written to help the reader create and experiment with his own circuits by combining standard type circuit building blocks. Circuits concerned with generating signals were covered in Book 1, this one deals with processing signals.

BP121: HOW TO DESIGN AND MAKE YOUR OWN PCBs $5.85
The purpose of this book is to familiarize the reader with both simple and more sophisticated methods of producing printed circuit boards. The book emphasizes the practical aspects of printed circuit board designs and construction.

BP122: AUDIO AMPLIFIER CONSTRUCTION $6.75
A wide circuits is given, from low noise microphone and tape head preamps to a 100W MOSFET type. There is also the circuit for 12V bridge amp giving 18W. Circuit board or stripboard layout are included. Most of the circuits are well within the capabilities of even those with limited experience.

BP125: 25 SIMPLE AMATEUR BAND AERIALS $5.85
This book describes how to build 25 amateur band aerials. The designs start with the simple dipole and proceed to beam, triangle and even a mini-rhombic.

BP127: HOW TO DESIGN ELECTRONIC PROJECTS $9.00
Although information on stand circuits blocks is available, there is less information on combining these circuit parts together. Practical examples are used and each is analyzed to show what each does and how to apply this to other designs.

BP130: MICRO INTERFACING CIRCUITS BOOK 1 $9.00
Aimed at those who have some previous knowledge of electronics, but not necessarily an extensive one, the basis of the book is to help the individual understand the principles of interfacing circuits to microprocessor equipment.

BP131: MICRO INTERFACING CIRCUITS – BOOK 2 $9.00
Intended to carry on from Book 1, this book deals with practical applications beyond the parallel and serial interface. Real world interfacing such as sound and speech generators, temperature, optical sensors, and motor controls are discussed using practical circuit descriptions.

BP136: SIMPLE INDOOR AND WINDOW AERIALS $7.00
People living in apartments who would like to improve shortwave listening can benefit from this book on optimizing the indoor aerial.

BP155: INTERNATIONAL RADIO STATIONS GUIDE $9.00
An invaluable aid in helping all those who have a radio receiver to obtain the maximum entertainment value and enjoyment from their sets.

BP174: MORE ADVANCED ELECTRONIC MUSIC PROJECTS $12.00
Complementing Book PB74, Electronic Music Projects,

BP174 provides projects, such as a flanger, a phaser, mini-chorus and ring modulators, percussion synths, etc. Each project has an Introduction circuit diagram and constructional notes.

BP179: ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF ROBOTS $12.00
The main stumbling block for most would-be robot builders is the electronics to interface the computer to the motors, and the sensors which provide feedback from the robot to the computer. The purpose of this book is to explain and provide some relatively simple electronic circuits which bridge the gap.

BP180: ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF MODEL RAILWAYS $9.00
Shows how home computers can easily be applied to the control of model railroads and other quite sophisticated control. A variety of projects are discussed as well as circuits for train position sensing, signal and electric points control, etc.

BP185: ELECTRONIC SYNTHESIZER CONSTRUCTION $9.00
With this book a relative beginner should be able to build, with a minimum of difficulty and at a reasonably low cost, a worthwhile monophonic synthesizer and also learn a great deal about electronic music synthesis in the process.

BP192: MORE ADVANCED POWER SUPPLY PROJECTS $8.00
Robert Penfold.
A companion to BP76, this book covers switched mode supplies, precision regulators, tracking regulators, computer- controlled supplies, etc.

BP225: A PRACTICAL INTRODUCTION TO DIGITAL ICs $7.00
This book deals mainly with TTL type chips such as the 7400 series. Simple projects and a complete practical construction of a Logic Test Circuit Set are included as well as details for a more complicated Digital Counter Timer project.

BP233: ELECTRONIC HOBBYIST HANDBOOK $15.00
A single source of easily located information: colour codes, pinouts, basic circuits, symbols, etc.

BP239: GETTING THE MOST FROM YOUR MULTIMETER $9.00
This book is aimed at beginners in electronics. Using the simple component and circuit testing techniques in this book the reader should be able to confidently tackle servicing of most electronic projects.

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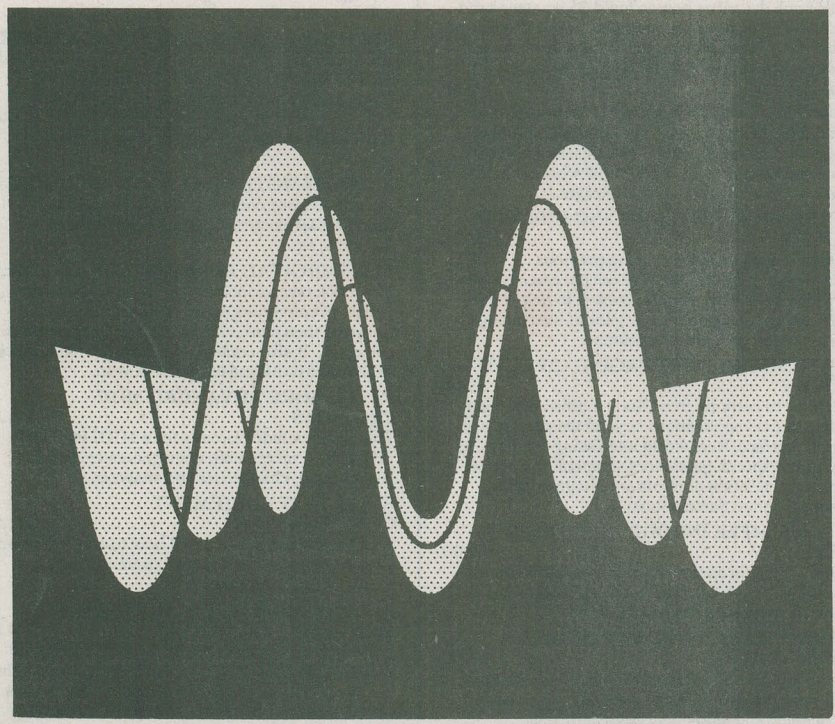
R.A. PENFOLD



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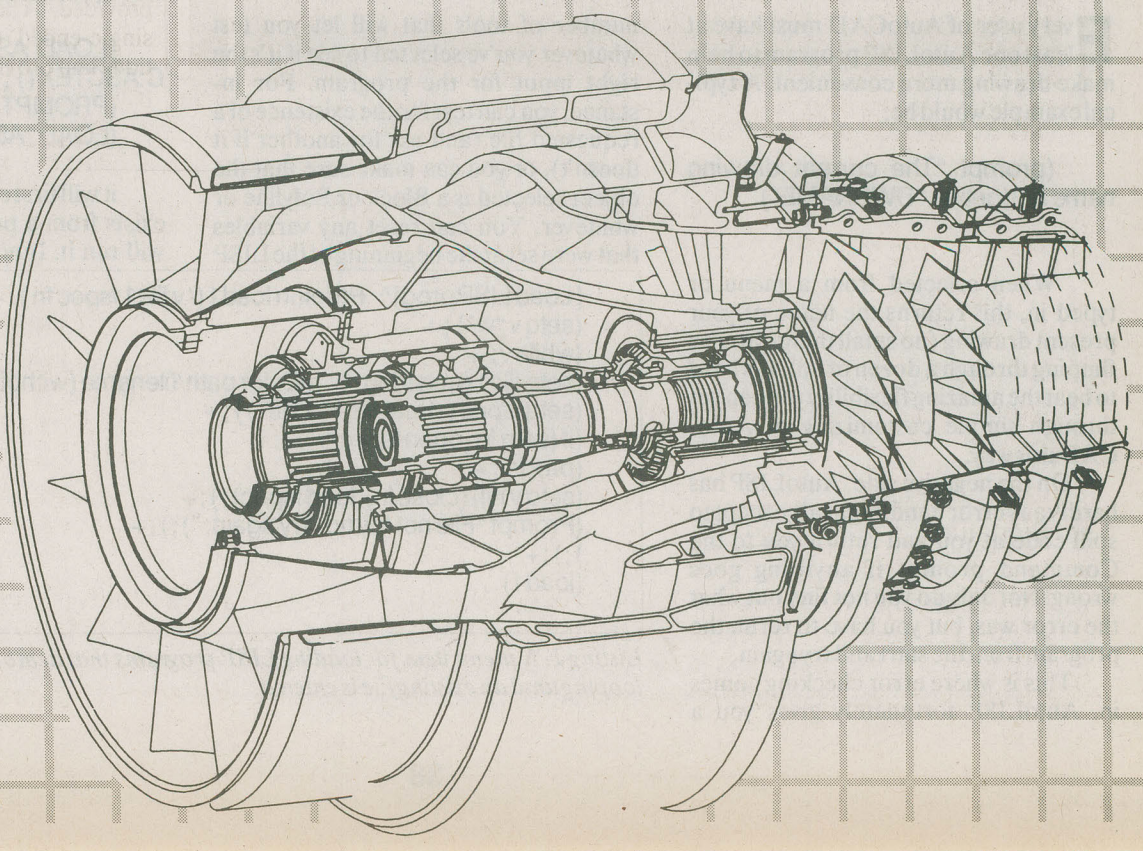
CAD/CAM Review



Error Handling in AutoLISP

Improve your programs with file testing, object checking and graceful exits.

Bill Markwick

Every user of AutoCAD must have at least one AutoLISP program to help make drawing more convenient. A typical example would be:

```
(prompt "The current drawing name is")(getvar "DWGNAME")
```

When selected from a menu or typed in, this returns the name of your present drawing (no small thing if you're flipping through a dozen or so). It's hard to beat the amazing flexibility you can get through simple customizing of AutoCAD this way.

On the negative side, AutoLISP has hardly any error handling at all, except to spill code at you and return you to the Command prompt if anything goes wrong. Not only do you not find out what the error was, but you have to rerun the program from the start and try again.

This is where error checking comes in. AutoLISP fortunately gives you a number of tools that will let you test whatever you've selected to see if it's the right input for the program. For instance, you can test for the existence of a requested file (and ask for another if it doesn't), or you can make sure that the object selected is a Block or Polyline or whatever. You can reset any variables that were set at the beginning of the LISP program, so that a termination doesn't leave a mess behind.

Reality rears its ugly head, of course. It's not unusual for the error checking section to be larger than the actual command section, and the error functions are poorly documented in every book I've seen (if they're in the book at all). You won't even get a whole lot of help from your AutoLISP Programmer's Reference from Autodesk (yes, it's a reference book for the programmer who doesn't need a reference book).

However, despite all the seesawing you've read above, you can adapt whatever level of error checking you want to your LISP commands. If you feel they bloat up your menu too much, use only the simplest forms of checking that I've sketched out. If you're writing a program that will be used by someone else and you aren't sure what they might do to it, include as much trapping as you want.

Simple Loading

Here's a quick program that checks to see if an AutoLISP command has previously been loaded, eliminating the wait while LISP compiles the command.

Suppose you use the LISP program ASCTEXT.LSP (included with AutoCAD) to load ASCII files to the drawing screen. If your menu line says [LOAD ASCII](load "ASCTEXT"), you'll have to endure compiling every time you select it, but if it says

```
[LOAD ASCII]^ P(COND ((NULL C:ASCTEXT) ;+
   (PROMPT "Loading...") ;+
   (LOAD "ASCTEXT")))
```

it will first check to see if ASCTEXT exists from a previous load and if so, it will run it. If not, it says "Loading..." (a

```
[Load LISP prog]^ P(defun load1 (/ v file1 fspec fn ) ;+
(setq v "w") ;+
(while v; +
(setq file1 (getstring "^ mEnter path/filename (without ext.): ")) ;+
(setq fspec (strcat file1 ".LSP")) ;+
(if (setq fn (open fspec "r")) ;+
(progn ; +
(setq v nil) (close fn)(load fspec) ; ) ;+
(Prompt "File not found. Try again: ") ; ) ;+
) ; ) ;+
(load1)
```

Listing 1. A menu item for loading LISP programs that demonstrates file checking and looping until an existing file is entered.

```
[Load/reload LISP]^ P(defun loadlisp ( ) ;+
(if lspfile (load lspfile) ;+
(progn (setq lspfile (getstring "Enter file to load (without ext.):")) ;+
(load lspfile))));+
(loadlisp)
[Clear above]^ P(setq lspfile nil)
```

Listing 2. A variation on Listing 1 that will load a LISP program and then reload it each time the menu item is selected, making debugging easier.

confidence message) and calls it in from the disk.

If you're not that familiar with LISP, the C: means "AutoCAD Command", not a disk drive. The semicolon and plus sign tell AutoLISP that there's more code on the next line - these are for LISP programs in an AutoCAD menu, and can be omitted for standalone programs. The ^ P is caret-P, not an actual control code, and it prevents onscreen scrolling of the LISP code.

There are several other ways of doing the same function, one of which appears below.

Another Loader

If the above command is used with a nonexistent file, it just stops working and returns the Command prompt. A nice feature is to incorporate a loop that tests the validity of a file before loading it. If the file doesn't exist, it asks you to try again.

Listing 1 is a loader for LISP programs that checks files for you. It's meant to be included somewhere in your AutoCAD menu, since it seems pointless to have to load your loader from the command line.

The first line defines the function "load1" and lists the variables (variables preceded by a right backslash are cleared when the program ends). The next line sets the variable "v" to non-nil (it could be anything, not just "w"). While this variable has something in it, the program asks for a filename without the extension, adds the extension LSP to it and then tries to open the file for reading (open fspec "r").

If the read function is successful, variable "v" is set to nil, stopping the While loop and loading the requested program. If it's not, an error message is printed and we go around again (and again, until a file is found or a CRTL-C is entered to stop the loop).

Note the ^ m (caret-m, not an actual code). This is used for scrolling a new line. The \n that you would normally use in LISP can't be used in menus because the left backslash is the menu symbol for a pause.

Programmer's Loader

If you write much LISP code, you've no doubt had the thrill of debugging over and over, loading and reloading until you get the weird syntax to behave or you give up in tears. **Listing 2** is a variation on Listing 1; it accepts a filename, but saves it in a variable that survives even after the LISP program ends. The next time you have to load the same file for debugging, just click on this one again. The previously stored filename is loaded so you can run it and pull your hair some more.

The last line of Listing 2 is another menu item that clears the variable that contains the filename, letting you load some other program.

You'll note that there's a minimum of error checking in Listing 2. This is because programmers like yourself never make mistakes. However, it's an interesting challenge to graft the error trapping of Listing 1 into Listing 2.

Initget

AutoLISP provides you with an input filter for any of the GET functions except Getstring and Getvar. The Initget filter can be set to refuse nulls, zeros, negative numbers and a few others (it's described in fairly good detail in the AutoLISP Programmer's Reference).

The syntax is:

(initget (*number*))
(setq a (getint "Enter non-zero integer"))

The *number* in the above is 1 for no nulls, 2 for no zeros, and 4 for no negatives. If you wanted all three, you could replace the number statement with (+ 1 2 4).

Checking Entities

The Redefine Block menu item in **Listing 3** is a good example of how error trapping statements can make up the majority of a program. All it does is use the AutoCAD Insert command to redefine an existing block using one from the disk. However, it saves you from having to remember the awkward syntax, and it works only with blocks and existing files.

It makes use of the entity list manipulation features of AutoLISP. Each

```
[REDEFBLK]^ P(defun rblock (/ y z a b c d name name2 v file1 fspec fn ) ;+
(setq y "w") ;+
(while y ;+
(setq a (entsel " Pick block to redefine:")) ;+
(setq d (car a)) ;+
(redraw d 3) ;+
(setq b (entget (car a))) ;+
(setq z (assoc 0 b)) ;+
(if ( =(cdr z) "INSERT") (setq y nil) (prompt "Entity is not a block."))) ;+
(setq c (assoc 2 b)) ;+
(setq name (cdr c));+
(setq v "w");+
(while v;+
(setq file1 (getstring " ^MEnter path/filename for replacement block: "));+
(setq fspec (strcat file1 ".DWG"));+
(if (setq fn (open fspec "r"));+
(progn;+
(setq v nil) (close fn));+
(Prompt "File not found. Try again:")));+
(command "Insert" (strcat name " =" fspec));+
(command nil nil));+
(rblock)
```

Listing 3. This menu item checks to see that a Block has been selected, and if not, prints an error message and starts again.

object (Line, Block, etc) in the drawing database has a list of parameters (the entity list). These include the name, type, start point, length and so on. In Listing 3, we're looking for the name, labelled "2" in the database. Curiously, a Block's name is "Insert". You can get further information on the drawing database from the AutoCAD manual, and from *Customizing AutoCAD*, New Riders Publishing. In brief, the numbering is pretty much the same as the DXF group codes (more to come on DXF codes in a future article).

First, we set up a While loop, described previously. When you select a block, the drawing database returns not its actual name, but a hex number and coordinates, which we store in variable "a". Picking the first item (car a) extracts the hex identifier so we can work with it.

The Redraw statement highlights the block (another confidence feature). The If statement checks to see that the "2" section of the hex identifier's entity list is indeed "Insert". If so, the loop is stopped (setq y nil) and the selected block name saved (setq name (cdr c)).

```
[ZEROWID]^ C^ C^ P(defun newerr (er) ;+
(if (/ = er "Function cancelled") ;+
(princ (strcat "^ mError: " r))) ;+
(setq *error* olderr) ;+
(princ)) ;+
(defun wid (/ a b olderr) ;+
(setq olderr *error* *error* newerr) ;+
(setq a "w") ;+
(while a; +
(setq a (entsel "Select polyline for zero width (CRTL-C to cancel): ")) ;+
(if ( = a nil)(newerr)) ;+
(setq b (car a)) ;+
(command "PEDIT" b "W" "0" "")) ;+
(wid)
```

*Listing 4. The *Error* function in AutoLISP menu item allows the user to define what will happen during an exit from CRTL-C or other cause.*

Next we get the filename, using the While loop previously described. If it exists as a DWG file on the disk, the file is saved in the "fspec" variable.

Finally, the blockname and filename are fed to the Insert command, which redefines the block and is terminated before it can actually insert anything (command nil nil).

Yes, it's a lot of jiggery-pokery just to do a simple command, but it's almost foolproof and it's much more convenient than just using the Insert command (if you can remember that redefining is a subfunction of Insert).

Almost foolproof? Well, try cancelling the program with a CRTL-C halfway through its operation. The command prompt area will fill up with aborted LISP code. Harmless, but it looks, well, amateurish. Read on.

Declaring Variables

Before continuing, a refresher on declaring variables in LISP. The first set of brackets after your "defun filename" contains the variables (or not). If the next symbol is just (), then all variables are *global*, which means that they remain as is when the program ends and can be used by other programs. If it looks like (/ *variable1 variable2...*), the variables are *local* and are cleared on exiting. Finally, if the symbol looks like (variable) with no backslash, then the variable can receive input from outside the program. It's this last feature that comes in handy when writing error checking functions.

Clean Exits

AutoLISP contains a user-definable variable called *Error*. Normally it's set to nil (empty), and in that case, any error (or CRTL-C) causes code to scroll as the program ends (the code is supposed to be for error tracing, though it rarely sheds a whole lot of light). However, you can define *Error* for any sort of exit you like.

Listing 4 contains a menu item that sets polylines to zero width, useful if you ever have to simplify a complex drawing (for making slides, for instance). The *Error* function receives input from AutoCAD via the variable "msg" and prints it ("Function cancelled" will result from a CRTL-C, for example). It then makes an exit. In the second part of the program, "wid" uses the Pedit command to reset the selected polylines. The function will loop until cancelled by a CRTL-C or a Return.

Really Clean Exits

Many LISP programs set certain variables before starting work. For example, if AutoCAD's Thickness is set to non-zero and the LISP program has to draw some temporary marker lines or arcs, the screen will look a bit hysterical as the huge marker lines are drawn and erased. Therefore, LISP sets the thickness to zero, and may well set Osnap and others to some particular value as well.

The problem here is that if you just

Listing 5 appears on page

```
;Hidearc.Lsp draws 3Dfaces inside an arc, bounded by the arc
;and a line across its endpoints (chord). Used for hiding filleted
;corners, etc. (c)1991, Bill Markwick
;
(defun newerr (er)  ;new error handler for clean exits
(if (/= er "Function cancelled")
(princ (strcat "\nError: " er))
)
(setq *error* olderr)     ;restore *error* handler
(setvar "osmode" osm)  ;and restore previous variables
(setvar "thickness" thk) ;before exiting
(setvar "highlight" hlt)
(princ)
)
;main program
(defun c:hidearc (/ pt1 pt2 pt3 pt4 osm hlt thk a b c d e f g h)
(setq olderr *error* *error* newerr) ;readies new error handler
(setq osm (getvar "osmode")) ;saves osnap setting
(setq hlt (getvar "highlight")) ;saves highlight setting
(setq thk (getvar "thickness")) ;saves thickness setting
(setvar "thickness" 0) ;sets zero thickness
(setvar "osmode" 3) ;sets osnap to End/Mid
(setq pt1 (getpoint "\nPick one end of the arc: ")) ;arc end
(setq pt2 (getpoint "\nPick a point near its middle: ")) ;arc mid
(setq pt3 (getpoint "\nPick its other end: ")) ;arc other end
(command "arc" pt1 pt2 pt3) ;draw new arc on top of old
(command "line" pt1 pt3 "") ;line from arc end to arc end
(setq pt4 (polar pt1 (angle pt1 pt3) (/ (distance pt1 pt3) 2))) ;line midpt.
(setq g (ssget pt2)) ;puts arc in selection set
(setq h (ssget pt4)) ;puts line in selection set
(command "Rulesurf" pt2 pt1) ;draw mesh
(command "explode" pt1) ;explode mesh to 3Dfaces
(setq a (ssget "c" pt1 pt3)) ;selection set
(setq b (sslength a)) ;number of 3Dfaces
(setq index 0)
(repeat b ;loop for each 3dface
(setq e (entget (ssname a index))) ;get entity list
(setq index (1+ index))
(setq c (assoc 0 e))
(if (= "3DFACE" (cdr c)) ;work with 3dfaces only
(progn
(setq d (assoc 70 e))
(setq f (subst '(70 . 15) d e)) ;change 70 to invisible (15)
(entmod f) ;write changes to drawing database
(prompt "\nChanging to invisible 3Dfaces.")
) ;end Then section
) ;end if statement
) ;end loop
(command "erase" g "") ;erases arc
(command "erase" h "") ;erases line
(setvar "osmode" osm) ;resets osnap to previous
(setvar "highlight" hlt) ;resets highlight to previous
(setvar "thickness" thk) ;resets thickness to previous
(command "redraw") ;cleans up drawing
) ;end
```

Listing 5. A program to draw 3Dfaces inside an arc, illustrating fairly comprehensive error trapping, especially resetting of variables after an interruption.

CAD

cancel the operation in the middle with a CRTL-C, the program bails out and leaves a mess behind. Using a modified *Error* function, you can get LISP to politely reset all the original values before exiting.

Listing 5 contains a fairly ambitious program with comprehensive error handling. Its purpose is to draw invisible 3Dfaces nesting into an arc, allowing you to easily match curves and rectangles in 3D work. If you don't need this function, just take what you want from the error handling statements and adapt them to your program.

First, the program defines its own error handler ("Newerr"). Later in the listing, Newerr and *Error* are swapped. Next, three variables are saved so they can be returned to their original values. Next comes the main program, with new names provided for the *Error* handler (the idea here is to prevent *Error* from sitting in AutoCAD with the program's old values—after exiting, *Error* is reset to normal). Next, the variables are set to suit the program, and reset on exiting (either normal exit or termination).

One thing is missing from the error handling: there is no erase function to remove anything drawn before an abort. However, once the drawing starts, CRTL-C won't interrupt it until it's finished. In other programs where you have a chance to insert a CRTL-C, you might want to put some Erase statements into the Newerr section of the program.

Finally...

I know I've covered a whole lot of ground in a short article, and I've probably left all sorts of questions unanswered, particularly with regard to the odd syntax of AutoLISP. However, there should be enough basics to let you add bulletproofing to short programs, at least. Happy CADDing.

AutoTEACH

Automated learning of AutoCAD

BY COURTNEY THOMPSON

For many AutoCAD learning is a nightmare. So much has been put into it over the years, that learning it today definately requires training. Private instruction may be prohibitive for individuals. A college class may be stretched out over too long a period or at inconvienient times. Ah, but there is a better way. Introducing AutoTEACH 1 by Compu-CAD Technologies. It is distributed by Datawiz of Bradford, ON with a suggested retail investment of $595.00 Canadian funds.

AutoTEACH 1 is a disk based learning system for AutoCAD (DOS or 386 versions) release 10 or later. Its advantage over learning from a book or listening to an instructor, is that AutoTEACH is used 'within' AutoCAD, while providing an controlled environment. It should be noted that AutoTEACH requires that you have your AutoCAD installed on your machine since AutoTEACH works 'within' the AutoCAD to create a live educational medium.

TAKING OFF THE WRAPPING

My first impression was - neat! It wasn't big and bulky looking like most other software packages that we're used to seeing off the shelf. The AutoTEACH package that we recieved consisted of: a disk, a thin (20 page) manual, and a note pad. The low use of paper would make any environmentalist feel more at ease.

Installing AutoTEACH is clear and to the point. The one page installation proceedure was well done. A note however, the explaination of some 'basic' terms or phrases such as 'boot', or avoiding such terms altogether (by saying; "Turn your computer off, then on again to let the changes take effect.").

To start AutoTEACH is simply a matter of going into the ATEACH1 subdirectory (created during the install) and type: ATEACH and press enter.

WHAT GREETS YOU?

The manual suggests these points for using AutoTEACH effectively: 1) Start at the beginning and work successively through the lessons. 2) Take notes (knew that note pad was included for a reason). 3) Redo a lesson if AutoTEACH suggests that you do and 4) Don't rush.

The main menu screen allows one to select either one of eight lessons, to go to the next successive lession or the end the program. One of the first questions you are asked in lesson one is: Do you want the sound on or off? If you are not a 'Get Smart' or 'Don Ho' fan leave it off. The guys at Compu-CAD obviously have a sense of humor. This makes the learning process more inviting. For those who aren't music fans, this stunt is offered in lesson one only.

At the outset of each lesson, there is a short introduction outlining the objectives of the lesson. To help the learning process, a combination of live demos, on screen lectures sessions and periodic quizzies are interspersed with hands-on exercises. At the end of the lesson there is a longer quiz to test you retention. The quizes help force you to think about and recall what you have just learned (that note pad does come in handy for this purpose).

If you think you can just passively skip through AutoTEACH, guess again. Not only does it quiz you, it monitors your response. If are quiz score or accuracy rate is deemed to be too low, AutoTEACH will suggest that you repeat the lesson. Starting with the end of lesson three, AutoTEACH gives you a drawing assignment to put into practise what you have learned.

The main topics covered by AutoTEACH 1 are: Lesson 1 - Getting into ACAD; offers a tour of the Main Menu in addition to introducing CAD terminology. Lesson 2 - Getting Around; shows one how to navigate inside AutoCAD using the mouse or tablet in addition to learning about various areas of the screen. Lesson 3 - Setting Up; teaches how to set up for drawing. Topics include, setting UNITS, GRID, SNAP, LAYERS and so on. Lesson 4 - Creating; shows how to draw basic elements: LINE, ARC, CIRCLE, SOLID just to name a few.

Lesson 5 - Changing; introduces editing concepts. Lesson 6 - Adding Detail; shows dimensioning and hatching techniques. Lesson 7 - Defining Blocks; how to create, store and use them. And Lesson 8 - I/O; learn here how AutoCAD takes in and outputs information with various devices.

TRAPS COMMON ERRORS

While doing the hands on exercises, AutoTEACH splits your screen in two: one showing the final objective, the other is your workspace to try to duplicates what AutoTEACH has on the left side of the screen. If you are asked to select the EDIT menu from the screen menu, AutoTEACH won't allow you to pick anything else. This is a great advantage over learning from a book because the book won't catch those type of mistakes, you must figure them out, this takes more time.

A BETTER WAY TO LEARN?

Is this the best way to learn AutoCAD? It is a great approach but remembering that each person responds best to a different method, and knowing how you learn best should qualify your choice of an effective training method.

Continued on page 44

AutoVUE

Viewing drawings quickly without AutoCAD

BY COURTNEY THOMPSON

Many of you realize that searching for a particular drawing created by AutoCAD can become a witch-hunt. This is especially true if a file was incorrectly named or filled in the wrong subdirectory. The only option the AutoCAD gives you is to call up the file and wait for it to come on screen to determine if it is the right one or not. If you have many large files, kiss about a part of the day good-bye hunting for your file. Enter AutoVue.

AutoVue is a software package that allows for the quick viewing, managing, printing, and plotting of drawing files (with a .DWG extention) created using AutoCAD. AutoVue can be invoked from within AutoCAD as a shell program or directly from DOS. The AutoVue screen can be subdivided into up to four windows in order to view many files simultaneously, thus making file comparison easy. Also, each file can contain several viewports. Scanned raster files (RLC and NRF) DXF and back-up (.BAK) files can be viewed using this product.

USING AUTOVUE

AutoVue commands can be used via mouse, tablet or keyboard. The software attempts to automatically recognize the type of digitizer (Summagraphics, Calcomp, GTCO, ADI digitizer or a mouse) that you have connected to your input communication port. This port is assumed to be the COM1 port. AutoVue initializes the communication port automatically in most cases. In the event that it can not (due to a strange configuration) the MODE program (supplied with your DOS) and be used. While testing the software we used a Logitech mouse, then a Hitachi tablet connected to COM2. AutoVue installed without the need for special parameter settings.

AutoVue supports most graphics cards either directly or through ADI 4.0. The user can force AutoVue to open the graphics card in a specific mode by specifying the appropriate parameter at the dos prompt when starting AutoVue. This is one of the rare occasions when you would need the manual.

Most of AutoVue's functions are accessed via 'pull-down' menus. Most of the commands are self-evident; ZOOM EXTEXTS, COPY, ERASE for example. If there are any questions there is both on-line help available, as well as the (oh no) manual. The manual is clear, concise, but you will rarely need it unless you have a non standard configuration.

To load a file requires selecting the FILE menu heading. When it pops down, select READ. A list of drawing files appear. Click on the required file and AutoVue will show it to you on the screen. If the file you are looking for is not in the current directory, it is just a matter of clicking on the directory option and entering the proper drive letter and subdirectory name.

AutoVue can be used as an effective front-end to AutoCAD. A drawing that is being viewed on the screen if desired can be automatically loaded into AutoCAD by selecting the ACAD option under the FILE menu. This action starts AutoCAD and loads the drawing file that was in the active AutoVue screen. This would save value time; letting AutoVue quickly review drawings until the right one is selected, insteat of waiting for AutoCAD to load the drawing (which is much slower) and then repeating the same labourious task if the drawing loaded was incorrect,

OUTPUT & EXTRAS

There are three printers currently supported by AutoVue: Epson, HP-Laser Jet Series II, IBM Proprinters and their compatibles. As far as plotters are concerned many plotters are also supported through the HPGL plotting format. A pleasant improvement over previous releases of AutoVue, plots can now be scaled.

Included for a limited time only are two useful utilities: AutoRecover and

AutoTEACH from page 42

DXFout. AutoRecover is designed to piece back together damaged drawing files. This can save your bacon on that large project that just happens to have the most important drawing file go strange and give FATAL ERROR messages, and it just so happens that you don't have a back-up. DXFout creates DXF files from your drawing (.DWG) files without one having to enter AutoCAD, call up the drawing and perform a DXFOUT function. After the special offer it will cost you extra to get these two life and time saving programs.

There is a 'redline' option for $195. This gives the one viewing the drawing the ability to highlight and mark up sections that need correction. The redlining does not become part of, and therefore does not alter the original drawing in any way, shape or form. It can be viewed by the designer making the corrections and then easily be discarded. Thinking 'green' a moment, think of all the trees that can be saved by doing most of your corrections electronically. It also saves time that would have been wasted plotting a drawing for the sole purpose of being marked up and later thrown away.

BENEFITS

The two main benefit of using AutoVue is freedom and speed. drawings can be viewed on 'any' IBM compatible with 640K of memory and a graphics card. Since it calls up .DWG, .BAK, .DXF, .RLC and .NRF files, these can be compared side-by-side without having to plot or print out each one so that a comparison can be made.

The speed at which it puts drawing files on the screen, makes it a definate crowd pleaser for both CAD designers, managers and teachers that must review several drawings on a regular basis.

WRAP-UP...

Since most of us have to use AutoCAD, we should have to suffer with it lethargic performance. At an investment of $295 (suggested list) it is less than AutoManager's $360 (suggested list), faster and it is a Canadian developed product. Recommended.

Distributed by: Cimmetry Systems 8300 Ch. Cote-de-Liesse, Suite 102 St. Laurent, PQ H4T 1G7 Tel: (514) 735-3219 Fax: (514) 735-6440
Price: $295 ($490 with Redline option)

CAD

It is good learning in the controlled environment that AutoTEACH provides because you have a good idea about how well you are doing throughout the course. The software allows you to use the tool that you will be working with (namely AutoCAD) right away in a controlled step by step approach. This instills confidence and helps reduce the learning curve.

THE BENEFITS

Being an educator, both privately and at the college level, AutoTEACH is welcomed. It provides basic level of instruction that is consistant. It also allows for an educator to either focus more on those having problems or on creating and delivering more advanced course thus thating away some of the drudgery of repeating the STRETCH command or the co-ordinate system for the 137th time.

To the student, the main benefit is being able to learn at ones owne pace, as opposed to a pace (too fast or slow) imposed by someone else. It allows for the constant evaluation of skills learned and is reinforced by the drawing assignments. The ability to review the material as often as needed to obtain a good grasp of the material provides for an uninhibited learning enviornment. Most of all, the fact that the student can see instantly what is on the screen instead of trying to relate the information from a book reduces the time to digest the subject at hand.

Businesses both large and small can save money by letting personnel get their basic AutoCAD training on AutoTEACH. This will help them 'weed-out' those with potential at less cost. Those who do well can be sent to more advanced CAD education via consultants or colleges knowing that it is a more worthwhile investment.

WRAP-UP

AutoTEACH 1 is the first in a series of on-screen tutorials for AutoCAD the $595.00 investment considering the benefits to be gained and being able to review it as needed (at no extra cost) is well worth it. This product is recommended.

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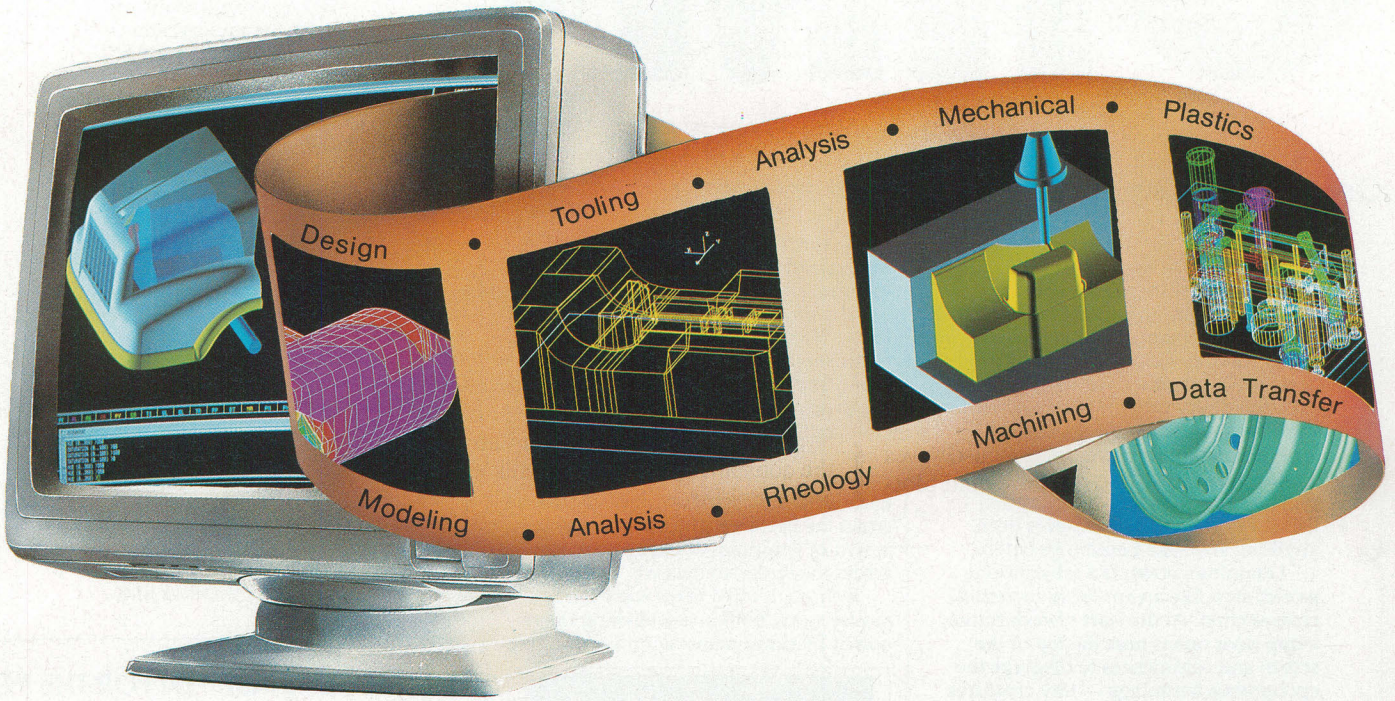

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BEAMSCOPE

Game of the month

Lemmings

Only you can save the lives of these self-destructive creatures.

Most segments of the software market seem to have stagnated of late. The most interesting new releases are incremental upgrades of existing products. For better or for worse, it seems that very few really original products are being brought to the business market.

Not so in the games market. Witness **Lemmings**, a truly bizarre, mind-bendingly original new release from UK-based Psygnosis. There's never been anything *quite* like Lemmings before.

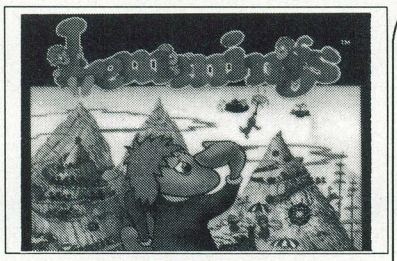
Lemmings presents a labyrinthine world, seen like an ant-farm, in vertical cross-section. At the start of each round, a trap door opens near the top of the screen and commences to disgorge the eponymous lemmings — tiny creatures with blue bodies and green hair. Left to themselves, lemmings do just one thing: they walk. They walk off cliffs, into flaming pits, under pounding hammers... anywhere they happen to be pointed.

It's up to you, the player, to keep the little lemmings from cheerfully immolating themselves. To save them, you choose special abilities from an icon menu at the bottom of the screen, then bestow these abilities on individual lemmings by pointing at them. The abilities are: climber (climbs obstacles), floater (survives long drops), blocker (forces other lemmings to turn back), builder (builds bridges), exploder (used to remove blockers or demolish obstacles), and three types of digger, horizontal, vertical and diagonal. You can assign each ability only a limited number of times, specified by a numeral above the icon.

In a typical round, you might first have to block the lemmings from dropping into a pit, then dig through and climb over several obstacles, then build a bridge. Finally, the lemmings reach the home gate and escape. Each round specifies a particular number of lemmings to be released, and the minimum percentage of these you must get safely home. There are four difficulty levels: fun, tricky, taxing and mayhem. Higher levels face you with larger numbers of lemmings, and fewer number of available abilities.

The simplest strategy in Lemmings is to use blockers to stall most of the traffic, while sending one or two lemmings ahead to dig tunnels or build bridges, as required. (You can almost *never* create enough floaters to save the entire lemming population from a precipice, or enough climbers to get them over a hill.) Once an escape route is prepared, self-destruct the blockers, and the remaining crowd of lemmings obediently troops across the screen to the exit.

Even so, it often takes some fancy mouse work, both in establishing the required blocking points and in controlling



the advance guard. Then you get to levels where you're allowed no blockers, or builders, at all...!

The VGA backgrounds in Lemmings are relatively static, but lovingly rendered. There are all sorts of horrible — but elegantly-drawn — ways for Lemmings to snuff it: flaming pits (they go with a sizzle), watery moats (they throw their arms up and drown), high drops (they spatter into little fragments), whirling grinders (similar to a drop, but the fragments travel farther), and so on. Self-destructed lemmings display a countdown over their heads, throw their arms up with a plaintive squeak reminiscent of "Mister Bill", and explode into a shower of colored dots.

Fortunately, at the Lemmings' tiny screen size none of this looks as gory as it sounds.

Lemmings is copy-protected, requiring the master disk to reside in drive A — so be sure and buy the correct-sized disks! Ad Lib support is excellent, with sound effects and music, each of which can be enabled separately. Alas, the animation doesn't seem to work correctly under Windows; we'd have liked to keep a Lemmings session permanently active in the background.

The biggest *potential* drawback with Lemmings is that — as with many other "puzzle" games — you really only need to solve the puzzles once. This places the game in marked contrast to such notables as SimCity, with its never-ending series of challenges, or even Tetris, which uses randomness to create an infinite variety of situations.

However, Lemmings is entertaining enough that one will almost certainly wish to replay the various levels many times. Further, having foreseen the limitation, Lemmings' designers have included a *huge* number of different game levels — 30 different challenges at each of the four difficulty levels, for a total of 120 in all.

Even so, we would hope that extra Lemmings levels — or a sequel — might be forthcoming from Psygnosis. We think that such follow-ups would have gamers flocking to their retailers like... well, you know.

BEAMSCOPE TOP TEN FOR THE PC

1.	**Wing Commander II**	**Origin**
2.	**Weapons of the Luftwaffe**	**Lucas Film**
3.	**Gunship 2000**	**Microprose**
4.	**Gateway Savage Frontier**	**Electronic Arts**
5.	**Terminator**	**Bethesda**
6.	**Might & Magic III**	**Electronic Arts**
7.	**Mega Fortress**	**Electronic Arts**
8.	**Castles**	**Interplay**
9.	**Wrath of the Demon**	**Readysoft**
10.	**Chuck Yeager's Air Combat**	**Electronics Arts**

BEAMSCOPE TOP 10 FOR NINTENDO

1.	TMNT 2	The Arcade Game
2.	**Battletoads**	**Tradeewst**
3.	**Powerblade**	**Taito**
4.	**Cyber Stadium: Base Wars**	**Ultra**
5.	**Bill Elliott's NASCAR Chalange**	**Konami**
6.	**Mega Man #3**	**Capcom**
7.	**Super Mario #3**	**Nintendo**
8.	**High Speed**	**Tradewest**
9.	**Teenage Mutant Ninja Turtles.**	**Ultra**
10.	**Lone Ranger**	**Konami**

Distributed in Canada by **Beamscope Canada Inc.**, 35 Ironside Cr., Scarborough, ON M1X 1G5; Phone: (416) 291-0000; Fax: (416) 291-5721.

Lemmings: Psygnosis Ltd, 29 Saint Mary's Court, Brookline, MA 02146; phone (617)7331-3553.

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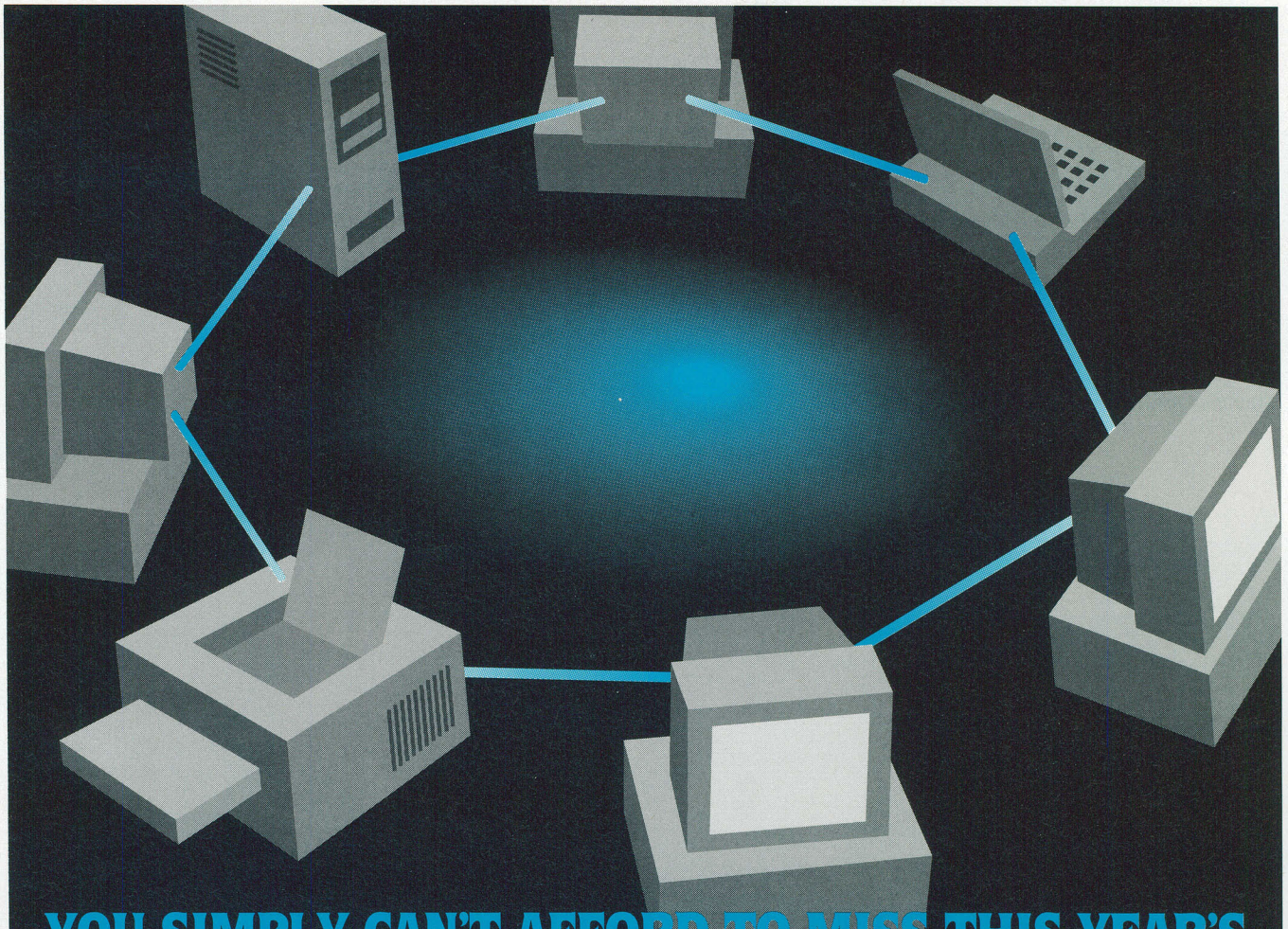

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